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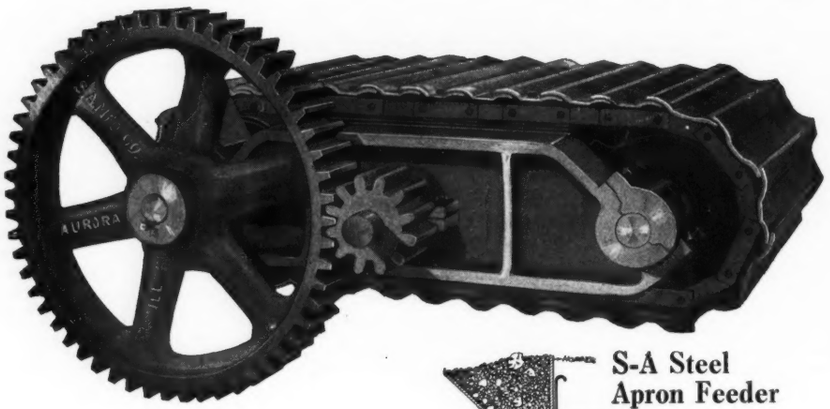

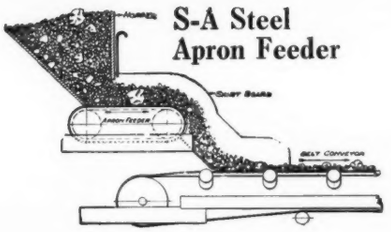

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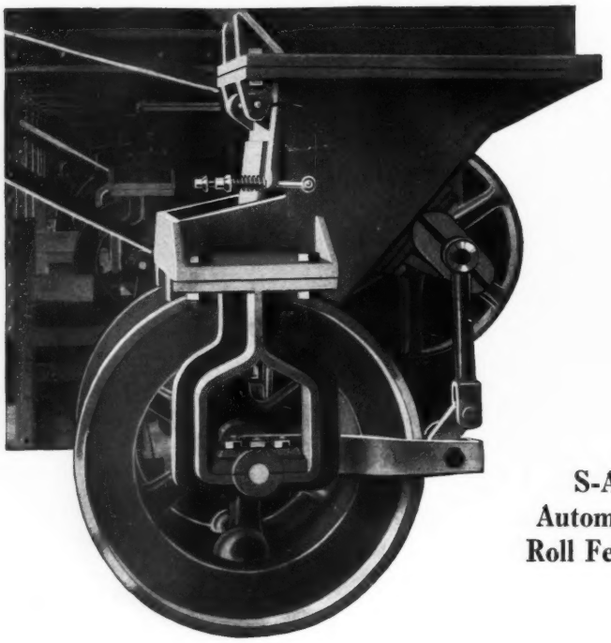

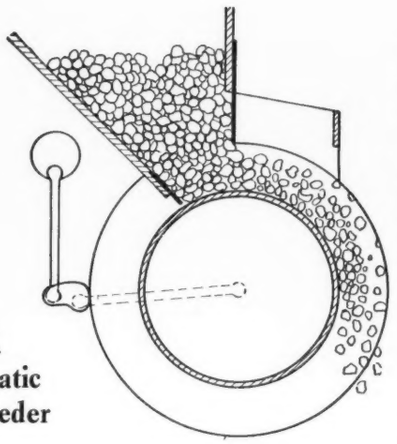

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Engineering and Mining Journal

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The Corocoro Copper District of Bolivia

By Joseph T. Singewald, Jr.,* and Benjamin LeRoy Miller†

SYNOPSIS—A description of a native-copper district in Bolivia that has been worked since the Sixteenth Century. Copper is found disseminated in sedimentary rocks, the age of which is open to several interpretations. Two types of orebodies, dipping in opposite directions, one containing native copper and one sulphide. Most mining operations in the hands of two companies. Milling method results itself into separation of sand grains and native copper, which is comparatively simple.

The Corocoro mining district in Bolivia shares the distinction with the Lake Superior district of the United States of being one of the two commercially important copper districts in the world in which native copper is the principal form of occurrence of the ore. It lies a short distance south of the Arica-La Paz railroad, which was completed about three years ago by the Chilean government in accordance with an agreement between it and the Bolivian government, at a distance of 340 km. from Arica and 100 km. from La Paz. A branch line 6 km. in length, constructed by the Bolivian government, connects Corocoro with Tarejra, a station on the main line. Topographically Corocoro is situated toward the western edge of the *altiplanicie*, or high plateau of Bolivia, in one of the groups of low hills that rise so frequently out of the level of the plain, and lies at an elevation of a little more than 13,000 ft. The city is strung out along several small valleys and gulches at the foot of the north slope of the Cerro de Corocoro, and the mines are located on the hills surrounding it. It is one of the most interesting of the larger towns of the high plateau in that, except for the white people of the staffs of the mining companies, the population is almost exclusively Indian, and the life and aspect of it show very little evidence of intercourse with the outside world.

Corocoro is an extremely old mining district. Upon the arrival of the Spaniards early in the Sixteenth Century, they found the Indians working these ores. Since those days work has gone on continuously and the district has been gradually increasing in importance. The total production from 1873 to 1912 was 200,000,000 lb. of copper. Until 1909 the mines were held under many ownerships, but in that year the Corocoro United Copper Mines, Ltd., was organized and consolidated a number of the properties, while practically all the remaining mines have been brought under the ownership of the Compañía Corocoro de Bolivia, a Chilean company organized in 1873. The annual production of the district has increased from $544,376 fifteen years ago to $3,820,821 in 1915.

FIG. 1. PANORAMIC VIEW OF COROCORO DISTRICT, BOLIVIA

The country rock of the district consists of a thick series of prevailingly red, gypsum- and iron-bearing shales, sandstones and conglomerates, the relative abundance of which ranges in the order named. These rocks have a strike nearly parallel to the direction of Corocoro Valley, which extends northward from the town at the base of the Cerro de Corocoro, or a direction of about N 30° W. The strike of the beds in the hill on the west side of the valley is parallel to the direction of the ridge and the valley, and their dip is steep to the west, ranging from 50° to 70°. The prominent characteristic of the series as exposed in this hill is the abundance of sandstone beds ranging in thickness from

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†Professor of geology, Lehigh University, South Bethlehem, Penn.

one to several meters. The strata lying to the west of this hill also have a westerly dip. On the east side of the Corocoro Valley is a less prominent ridge, or range of hills, in which the strata have an easterly dip and also lie somewhat flatter. In the series or rocks outcropping in this ridge, sandstones are less prominent and shales more abundant. These same shaly strata with easterly dip also underlie the valley itself, as they can be seen at a number of points on the lower slopes of the ridge on the west side of the valley. The strike of these beds is more northerly than of the westerly dipping beds.

Study of Geologic Conditions

The relations that have just been described are well brought out in the panorama of the Corocoro district shown in Fig. 1. They are such as to indicate that the two series of rocks are separated by a fault, though the fault plane itself can not be plainly seen in the vicinity of Corocoro. About 3 km. above the city, near the head of the Corocoro Valley, however, the position of the fault is distinctly exposed in a steep bank along the river. It is there seen that the fault plane is nearly parallel to, though a little steeper, than the westerly dipping strata and that the easterly dipping strata have an upward drag that steepens their dip close to the fault plane, and that consequently the fault is a reverse fault. The strike of the fault is parallel to that of the westerly dipping beds, so that the strata of the eastward-dipping series diverge from it from south to north and consequently successively lower beds emerge to the surface in that direction. These relations are indicated in Figs. 3 and 4. The fault has been recognized by all the workers in the region and according to Sundt extends 20 km. to the north to Pisaca, where mineralization similar to that at Corocoro has occurred, but to the south it passes into a normal anticline. Though the region as a whole has been one of considerable igneous activity, no igneous rocks have been found in the immediate vicinity of the mines. The nearest rocks of that character are found on Chukapaca, 15 km. to the west, and on the Cerro de Comanche at Mirikiri, 20 km. to the north.

A phenomenon of considerable geologic interest is the occurrence of a conglomerate dike on the east side of the Guallatiri River opposite the Guallatiri Chico mill. It can be traced on the surface for a distance of about 200 m., cutting across the shales with a strike of N 89° E and dip of 75° S, and has a width of 1 to 1½ ft. An open fissure apparently at one time extended to the surface and had washed into it sand, gravel and cobbles up to 6 in. diameter, which consist of both sedimentary and igneous material. This filling became indurated, and later movements along the bedding of the shales have produced several minor offsets in it.

Age of Rocks Open to Several Interpretations

Since red-colored strata are found at a number of horizons in the sedimentary series of Bolivia from the Silurian to the Quaternary and since such beds are usually characterized by a scarcity of fossils, it is not surprising that there has been much difference of opinion and difficulty in trying to arrive at the age of these rocks. Over 50 years ago, d'Orbigny determined them as partly Carboniferous. In 1860 Forbes, on account of the absence of fossil evidence, said there was no justification for dividing them and regarded all either Permian or Triassic, and most probably Permian. L. Sundt in 1892 placed the series on the west side of the fault in the Cretaceous, and that on the east side in the Tertiary. Steinmann in 1896 regarded them as part of a thick series of red-colored beds that underlie much of the Bolivian plateau and called them the Puca sandstone, *puca* being the Quichua Indian term for red. He divides the series into three parts: A lower, consisting chiefly of sandstone; a middle, made up of red clays with gypsum and salt beds and underlain by a fossiliferous limestone; and an upper, which comprises the greater part of the series and is chiefly sandstone. The strata on the west side of the fault he correlates with the lower division and those on the east with the middle division of the series. On the basis of fossils found in the Potosi region, he ascribes the series to the Cretaceous age.

Though Forbes and others mention the occurrence of carbonized conifer wood, Steinmann failed to find any;

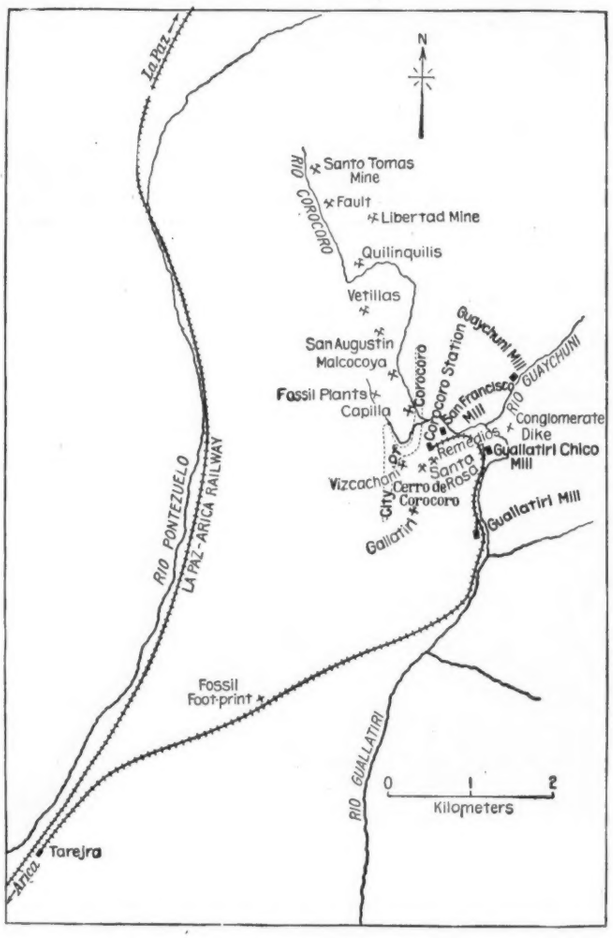

FIG. 2. MAP OF COROCORO MINING DISTRICT, BOLIVIA

and since no one in the district knew of its existence at the time of his visit, he concluded that it must be of very rare occurrence. The recent discovery, therefore, of determinable fossil remains is a matter of considerable importance and scientific interest. We are indebted to Fernando Dorian, general manager of the Corocoro Copper Mines, Ltd., for having shown to us a ledge of sandstone northwest of the city from which we were able to collect fossil leaves, and also for a plaster cast of a fossil footprint found along the railroad between Tarejra and Corocoro, the original of which is in his office at Corocoro. The former have been very kindly

determined for us by Prof. Edward W. Berry, of the Department of Geology of the Johns Hopkins University, and the latter by Prof. Richard S. Lull, of Yale University. The statement made by Professor Berry in regard to the plants is the following:

> The material submitted comprises about 25 pieces of rock having every appearance of a tuff and heavily charged with fragmentary fossil plants. The recognizable material without exception is of plants belonging to the class Dicotyledones, and where they are generically determinable they are of relatively modern types and such as are still represented in the flora of South America. At least four of the forms are identical with described or figured species from the plant-bearing tuffs of Potosi. These are:
>
> Cassia ligustrinoides Engelhardt, Sitz. naturw. Gesell. Isis in Dresden, 1887, Ab. 5, p. 37.
>
> Mimosites linearis Engelhardt, Ibid., 1894, Ab. 1, p. 13, Pl. 1, Figs. 21, 35.
>
> Unnamed leaf, Britton, Trans. Am. Inst. Min. Eng., Vol. 21, 1893, p. 259, Fig. 64.
>
> Characteristic fruits of a Terminalia, probably Terminalia antiqua Britton, Ibid., p. 254, Figs. 16, 28, 68-70.
>
> It seems evident that the Corocoro plant bed must be considered to be very nearly if not the exact age of the plant-bearing tuffs of Potosi. The age of the Potosi plants has never been definitely determined, since all the plants have been confined to this one locality. They have, however, usually been considered to be Pliocene because of the large proportion of forms close to species still existing on the upper slopes along the eastern front of the Andes and within the eastern Andes.
>
> I should say that the evidence of the fossil plants indicates positively that the plant-bearing layer at Corocoro is of Tertiary age, and I consider it very probable that it is late rather than early Tertiary.

In regard to the footprint Professor Lull says:

> It comes nearest to anything that I know of to the specimen figured on page 226 of my memoir on the "Triassic Life of the Connecticut Valley," Bulletin 24 of the Connecticut Geological Survey, known as Cheirotherium parvum, of which the original type specimen is preserved in the museum of Lafayette College and comes from Milford, N. J. It is unique so far as I know and cannot be exactly placed stratigraphically with reference to the geological column published opposite page 20 of the bulletin referred to. At the same time it comes within the limits of the Newark formation.
>
> The track is undoubtedly that of an amphibian and forms allied to it, Cheirotherium proper, come from the Buntsandstein of Hildburghausen, Germany, and also from the Lower Keuper of Storeton, Liverpool, England, and I have never known them either from older or newer rocks. I should therefore feel that it were fairly safe to ascribe this specimen, especially in view of its having been found in red sandstone, to the Trias, and probably within the limits from the Buntsandstein to the summit of the Trias, as I have already said.

Professor Lull does not regard the determination of the single footprint as absolutely certain, but if he is correct in his interpretation of it, one is almost forced to the conclusion that the red-colored rocks in the vicinity of Corocoro do not represent a single series. It is diffiuclt to believe that such special conditions as gave rise to these strata existed continuously from Triassic to late Tertiary time. Since the stratigraphic relations of the two fossil-bearing horizons are unknown, there is no reason for doubting Professor Lull's determination, and it seems probable that these beds are at least in part Triassic and in part late Tertiery in age. The plants, concerning the age of which there is greater certainty, come from the same horizons in which the *vetas* occur and hence fix the age of their immediate country rock as late Tertiary, and consequently that of the mineralization as the same or younger.

As regards their position, three types of orebodies are recognized, known as *vetas, ramos* and the *dorado.* The *dorado* is the name applied to an orebody that was found in the fault plane previously mentioned and is now practically worked out. Mr. Louis Gasqual, consulting engineer of the United Copper Mines, Ltd., said it was a shoot of rich ore that lay in the fault plane at the intersection of it with the *ramos* zone. The important orebodies have been and are the *vetas* and *ramos.* They are not, as their names would imply, fissure fillings, but are mineralized beds of sandstone in the shale-sandstone series. Those in the westward dipping rocks are termed *vetas,* those in the eastward dipping series *ramos.* Since the sandstone beds are thicker and more prominent in the former series, the *vetas* are said to average thicker than the *ramos.* In both series mineralization has occurred at a number of closely spaced horizons, but at only a few to form important orebodies. The thickness of the mineralized beds varies from a few inches up to as much as 10 or 12 ft.

The active mining operations are centered about the Cerro de Corocoro and the south end of the ridge on the west side of the Corocoro Valley. Here the *vetas* outcrop, but the *ramos* are first encountered in depth. As a result the shafts have been put down in the territory of the *vetas,* have encountered in depth a zone of disturbance, and then passed into the *ramos* ground, as shown in Fig. 5. On account of the geologic structure along the fault plane, the zone of the *ramos* has an upward pitch toward the north and finally emerges to the surface in the northern part of the district in the vicinity of the Libertad mine.

Different Interpretations of Geology

An entirely different interpretation of the relations of the *vetas* and *ramos* is held by Mr. Dorian and Adrian Berton, chief engineer of the same company. They believe that the *vetas* and *ramos* in the vicinity of Corocoro are one and the same thing and both lie to the west of the fault; that there is a southward pitching zone of disturbance that has more or less dislocated the *vetas* and reversed their dip, as illustrated in Fig. 6. The eastward dipping *ramos* in the vicinity of the Libertad mine and on the east side of the fault they regard as entirely distinct from the *vetas,* but that where the dip of the *vetas* was found to change to the east underground, the name *ramos* was also given to that portion of them, and subsequently it was erroneously concluded that both sets of *ramos* were the same. Unfortunately the levels of the mines which were visited that are now in active operation are in the *ramos* zones and it was no longer possible to observe the zone of disturbance or see much of the *vetas* in depth, so that it was impossible to decide between the two interpretations from the underground observations. However, all the surface observations are against the latter view and favor the former. It is planned to open up the deeper horizons of the *vetas* in the Vizcachani shaft, which is the most important in the district, by crosscutting to the west from the *ramos* territory. This crosscut will decide definitely between the two views, as according to the latter no ore should lie west of the *ramos* zone, whereas, according to the former such a crosscut should encounter the fault and beyond it the westward dipping *vetas.*

As previously stated, the orebodies are not true veins, but sandy layers in the sedimentary series that have become impregnated with ore. The mineralizing solutions that saturated these beds have bleached them and to a large extent removed the original cementing material. The impervious shales between these sandstones have not been affected by the solutions. Wherever mineralized, the

beds have lost their red color and are white or light green. At many places where the bed is not mineralized throughout, there are residual patches of red rock with a narrow transition zone grading into the bleached rock. Such patches of unbleached rock do not carry ore. The bleached rock is also as a rule soft and friable as though much of the cement that held together the sand grains had been removed. There have been some transverse displacements and movements along the bedding, as is evidenced by slickensides, particularly in the shales between the ore beds, but the amount of movement has not been sufficient to greatly disturb the position of the orebodies.

Native Copper Found in the Ramos

In the *ramos* the ore is entirely native copper, and occurs chiefly in the form of small particles disseminated through the sandstone. The ordinary rich ore is called *tacana;* if the particles of native metal are coarse, it receives the name of *chafra.* In extremely rich ore the sand grains are so knitted together by the copper that, although extremely soft, it is very difficult to break on account of its toughness. Plates and arborescent forms

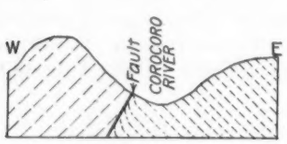

FIG. 3

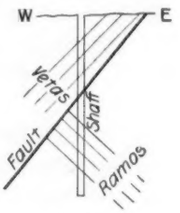

FIG. 5

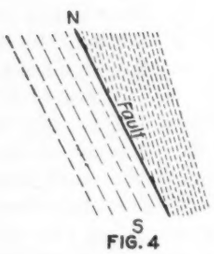

FIG. 4

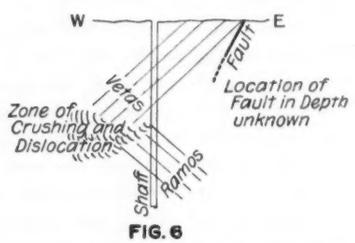

FIG. 6

SECTIONS SHOWING RELATIONS OF VETAS, RAMOS AND FAULT PLANES

of copper are also found abundantly as filling of joints and cracks and openings along bedding planes. These are called *charqui.* According to F. A. Sundt, manager of the Compañía Corocoro de Bolivia, the rock in the vicinity of *charqui* is poorer than the average, suggesting that the copper had been deposited in that form in those places instead of having been disseminated in the bed.

Gypsum and, less abundantly, barite and celestite occur as gangue minerals, but chiefly in association with the *charqui.* Of great mineralogic interest are also the pseudomorphs of native copper after aragonite that are found in such perfect crystals.

In the lower part of the *vetas* the mineralization is identical in character with that which has just been described in the *ramos.* But toward the surface the ore of the *vetas* is chiefly chalcocite with which are associated domeykite and other arsenic and sulphur compounds of copper in smaller quantity. Close to the surface these sulphides have undergone oxidation and there is an abundance of the green basic copper sulphate, considerable malachite and azurite, and also cuprite. The depth to which these sulphides extend varies in the different *vetas,* but is in the neighborhood of 100 to 150 m., below which only the native copper is found. The cause of this difference in the mineralogic constitution of the ore is not at all clear, and it is a most unusual phenomenon.

The close place association of the mineralization in the *vetas* and the *ramos* with the fault plane would suggest some relation between it and the fault, and such has been assumed to exist by most writers on the origin of it. Domeyko in 1880 regarded the fault as marking the ends of electrodes formed by two series of beds in contact along it, the centers of which were the chains of the Andes. The copper solutions derived from the decomposition of the metallic content of the mountains were reduced, and the metal was deposited at the end of the electrodes.

Twenty years earlier, in 1860, Forbes, on the other hand, looked upon the copper content of the rocks as syngenetic. His idea was that the beds carried syngenetic oxide of copper. The diorite intrusions of the region caused the fault and permitted the escape along it of sulphurous fumes. These reduced the oxide of copper to the metallic state and were themselves oxidized to sulphuric acid, which reacted with the calcareous content of the beds and gave rise to the gypsum.

In 1892 L. Sundt pointed out that the manner of occurrence of the copper, the pseudomorphs after aragonite, the occurrence at a number of horizons and other features indicate that the copper was introduced subsequently to the formation of the rocks. The mineralizing solutions he believed were introduced in the form of sulphate and chloride and that they reacted with calcium carbonate in the rock, giving rise to gypsum and copper carbonate. Decomposing organic matter reduced the ferric oxide, which gave the red rocks their color and thus bleached them, and the copper carbonate was reduced by the same means to native copper.

Steinmann's Explanation of Ore Deposition

Steinmann explains the chemistry of the process in an entirely different way. He believes the mineralizing solutions here were analogous with those that formed the other copper deposits of the Andes; that is, characterized by the presence of sulphur and arsenic to the subordination of oxygen. On coming in contact with the ferric oxide of the red beds, they reduced it and bleached those strata and the sulphur was oxidized to sulphuric acid. On account of the greater affinity of sulphuric acid for lime, magnesium and iron, the sulphates of those metals were formed and copper was set free. Since the lime sulphate is the least soluble of these, it remained behind as gypsum. The advantage of this theory he says is that it brings these deposits in the same category with the other copper deposits of the Andes.

While there are no igneous rocks exposed in the immediate vicinity of the mines, their occurrence not far distant has been mentioned, and further, the district lies within a belt of dioritic rocks that Steinmann thinks are late Tertiary in age. Moreover, the mineralization itself is not a local phenomenon, for though Corocoro is by far the most important, similar mineralization is found extending across Bolivia from Lake Titicaca to south of the Antofagasta and Bolivia railroad. Hence there would seem to be no objection to ascribing the mineralizers to some underlying magmatic source, even though there are no exposures of igneous rocks at

Corocoro. Morevover the determination of the age of the inclosing rocks, and hence the maximum age of the mineralization, is in harmony with Steinmann's determination of the age of the dioritic rocks the parent magma of which probably was the source of these mineralizers.

Most of the mines of the district are now in the hands of the two companies, known as the Corocoro United Copper Mines, Ltd., controlled by French and English capital, and the Compañía Corocoro de Bolivia, a Chilean company. The Libertad mine, owned by José Sossi, is regarded as one of the most promising of the independent mines.

The Compañía Corocoro de Bolivia now has four mines in operation: The Remedios, which produces 150 tons daily of native copper ore averaging 4%; the Capilla, with a daily production of 40 tons of native copper ore carrying 6%; the San Augustin, which has an output of 15 tons of similar ore with 15% copper; and the Malcoya mine, which was just being opened at the time of our visit and had not yet reached the producing stage. These ores are all treated at the San Francisco mill of the company, which last July was treating 200 tons five days a week though its capacity is 300 tons.

The principal mine of the Corocoro United Copper Mines, Ltd., is the Vyzcachani, which is worked by means of a shaft 390 m. deep. Others are the Santa Rosa and Guallatiri and a number of smaller mines north of the town. The ores of this company are treated in three mills—the Guaychuni, the Guallatiri Chico and the Guallatiri. The first-named treats 150 tons daily, the second 100 tons, and the last a smaller amount. In fact, the Guallatiri group of mines is about worked out and the ore is brought to that mill from other mines. The reason for having the three small mills instead of one large one is the inadequate water supply so that the same water must be used successively in the different mills. The average grade of the ore treated is said to be 2½ to 3% copper.

Sulphide Ores Now Profitably Worked

The advent of the railroad has reduced transportation costs to such a figure that it is now profitable to work the sulphide ores, and these promise to furnish an important part of the future production of the district. Until three years ago it was necessary to pack the concentrates to the Rio Desaguadero, then take them down the river in barges to Lake Titicaca and across it to Puno, and from Puno by rail to the seacoast at Mollendo. They now go by rail direct from Corocoro to the seacost at Arica at a cost of 16.20 bolivianos (about $5) per ton. Under the old conditions only the high-grade native copper concentrates could pay the cost of transportation, but now high-grade sulphide ore can be exported. This ore is hand-sorted to average 18 to 20% copper, which is the exported product, and the lean material is being stored for future concentration. Experiments on these ores with flotation methods are said to be yielding favorable results. The output of the sulphides is being greatly restricted owing to the scarcity of cars on the railroad, the number available being but little more than needed for the native-copper concentrates, with the result that both companies have several thousand tons of sacked sulphide ore waiting shipment. The European company had been producing 30 cars of sulphides per month.

One of the great drawbacks of the district has been the scarcity and high cost of fuel. Up to the present time *taquia*, the llama droppings, has been almost the only fuel, and the Corocoro United Copper Mines, Ltd., uses 10,000 tons of such fuel annually. Normally the price is about 60 centavos per quintal, which is about $4 per ton, but competition between the two large companies to obtain an adequate supply at times drives the price to nearly double that figure. The fuel value of the *taquia* is about one-third that of good bituminous coal. With present railroad facilities, the fuel problem is being met through the installation of Diesel engines and the use of petroleum.

The labor of the district is entirely Indian and comprises the men, women and children, the women even being employed underground. Nine hours constitute a shift underground, and there are two shifts a day. The day shift works from 8 to 11, rests from 11 to 12, and works again from 12 to 5 in the afternoon. On the surface, the hours are from 7 to 11 and from 12 to 5.30. The men received 1.80 bolivianos per day and the women 60 to 80 centavos.

Milling Consists of Concentration

The milling methods required to concentrate an ore consisting essentially of native copper and sand grains are naturally quite simple, and the four mills of the district are more or less alike, so that descriptions of the San Francisco mill and the Guallatiri Chico will suffice.

The ore treated in the San Francisco mill is trammed from the Remedios tunnel and brought by aërial trams from the San Augustin and Capilla mines to a platform above a Blake-style crusher, where lumps that are too large for the crusher are broken up by hand with sledges. The crushed ore passes to four chilean mills in which it is ground to pass screens with openings ⅛x½ in., from which the pulp goes to a second set of impact screens with $\frac{1}{16}$-in. openings, the oversize of which is returned to the chilean mills and the undersize goes to a 6-spigot hydraulic classifier.

The classification makes three sizes, two spigots to a size, each of which feeds a three-compartment Harz jig with $\frac{1}{16}$-in. screens. The discharge of the three compartments is mixed to form one product that carries 50 to 60% copper. This is cleaned on a fourth jig, which yields a final product from the first compartment only with 85 to 90% copper. The second- and third-compartment products from this jig are re-treated on the same jig. The tailings of the four jigs go back to the chilean mills. The overflow of the classifier is settled in a spitzkasten and the settlings distributed to three Overstrom tables. The concentrates of these tables are cleaned on a fourth that yields a 95% product, by cutting a middling that is re-run over the table. The table tailings carry 0.3 to 0.5% copper, which is lost. The jigs recover 90% of the concentrates and the tables 10%, while the loss in milling is from 10 to 15%. The concentrate is dried in the sun on an open stone pavement and sacked for shipment.

The ore that comes to the Guallatiri mill is crushed at the mine to 4-in. size and brought down by an aërial tram, from which it is dumped into a bin that feeds three chilean mills and ground to pass at 1½-mm. mesh screen. The pulp is elevated to a classifier which feeds two two-compartment jigs with 2-mm. screens. The two compartments of the jigs yield a product that

averages 60% copper and that on cleaning on a third jig of the same kind gives a first-compartment product with 85% copper. The jig tailings are returned to the chilean mills.

The overflow of the classifier is distributed to four Wilfley tables which produce a concentrate with 85% copper, a middlings that is returned to the chilean mills and tails that carry 0.5% copper. The tails are run into a sluice to settle and the settlings sent back to the chilean mills. A furnace was installed at this mill to produce copper ingots, but in the first run the copper was absorbed by the brick lining and the bricks broke loose and floated, so that operations had to be stopped. It is planned to obtain new bricks and experiment further.

Potash from Blast Furnaces

As the production of raw potash in the United States is a small percentage of the annual consumption, European War conditions have caused a dearth in this country. The attendant higher prices have been an incentive to research and industrial development. The results of research into the methods and procedure in the recovery of potash from blast-furnace byproducts are given in a paper to be presented at the New York meeting of the A. I. M. E., February, 1917. The paper is entitled "Potash as a Byproduct from the Blast Furnace," and has been prepared by R. J. Wysor, blast-furnace superintendent of the Bethlehem Steel Co.

Investigation into the original source of the potash showed that it occurred almost entirely in some form of feldspar or clay in all the material entering the blast furnace. Of the variety of ores treated at Bethlehem, the manganese ores were found to contain relatively high percentage of potash, as compared with most of the iron ores. The potash content of the flux (limestone and dolomite) used at Bethlehem is higher than in the average ore or coke charge. Connellsville coke was found to have a lower alkali content than the local byproduct coke made from West Virginia coals. Analyses of slag and flue dust showed that the ore contributed 46% by weight of the potash constituent, coke 26% and flux 28%.

It is probable that a considerable part of the potash and soda charged into a blast furnace is evolved from the top by direct voltilization or heat decomposition, though alteration by chemical reaction of the alkaline salts or compounds liberated may occur before they have left the furnace. It is certain that a large part of the alkalies are carried down into the hotter zones of the furnace and are converted into cyanides by reaction with red-hot carbon. Whatever the action, it is self-evident that eventually the same amount of alkalies must be carried out of a furnace that is charged, and this takes place somewhat as shown in the accompanying table.

	%
Lost in slag	20.0
Lost in fume	2.0
Lost in gases	3.9
Wastage from mains	0.4
Lost in stack gases	11.2
Total lost	37.5
Removed by primary washers	55.9
Removed by secondary washers	2.2
Total removed	58.1

Knowing the exceedingly fine state of division and smooth, spherical nature of the ultimate particles in this fine fume, there is little cause for wonder that so much of it passes through a creditable wet washer untouched.

The water-soluble potash content of the dry, ignited dust recovered from the stoves and boilers, having previously passed through the wet washers, will vary from about 5 to 20%. The average of 36 carloads shipped showed a potash content of 9.9%. Calculated on the basis of pig iron produced, 0.3 lb. potash was recovered per ton of pig iron.

At furnace plants using burdens rich in potash where the gas is unwashed, a considerable recovery still can be effected, though some precautions must be taken to avoid the coarser, raw flue dust. Several furnace plants in the East have been recovering potash-bearing flue dust during the last year and a half.

In the present gas-cleaning practice it appears that there is a loss in the primary washers alone of over half of the total potash charged, or about 12 lb. per ton of pig iron produced. The amount recovered, while appreciable, and representing almost clear profit, is seen to be an insignificant part of the total, less than ½%. Potash lost in the slag, around the shell and from the top of the furnace, for all practical purposes is lost beyond recovery. The greater part of the alkali content of the flue dust removed from the dust catchers could be recovered by leaching in water, but the percentage is too low to justify reclamation in this way. However, the potash now lost in wet washers and from stove and boiler-house stacks offers a legitimate and inviting field for its recovery. According to the balance sheet, it appears that about two-thirds of the total potash charged is now lost in the wash water and stack gases, or about 15 lb. per ton of pig iron produced.

At intervals during the course of the last year or more there has been in operation at Bethlehem an experimental Cottrell electric dust precipitator connected to the raw gas main leaving one of the dust catchers. Practically all the dust and fume entering the treater could be precipitated successfully. The color of the dust recovered varied from a light to a dark gray. Several samples were analyzed and showed a potash content of about 10%. The total dust leaving the dust catcher is much richer in potash than the relatively heavy particles constituting the dust in the dust catchers. For average practice there should be recovered, per ton of pig iron produced, not less than 12 lb. of total and probably about 9 lb. of water-soluble potash now lost in washers and stacks.

Russian Manganese-Ore Shipments

Shipments of Russian manganese ore from the ports of Poti and Batum in 1916 were 9769 net tons of Tchiatursk ore, against 9750 tons in 1915 and 788,214 tons tons in 1914. By the Tchiatursk side line there was forwarded from the Tchiatursk district 131,934 tons in the 1916 period, of which 60,742 tons was further forwarded by land. In the fiscal year 1915 shipments from this district were 35,246 tons, and in 1914 they were 787,661 tons. These data are given by the statistical bureau of the Council of Congresses of Miners of Manganese Ore, and were published in *Iron Age,* Jan. 11, 1916. The price of the ore, which in the first three months of 1916 did not exceed 8 to 9½ kopecks (about 4 to 5c.) (100 kopecks = 1 ruble = 51.5c.) per pood, has risen to 20 to 22 kopecks (about 10 to 11.25c.) per pood (1 pood = 36.11 lb.) This is an advance from $2.50 to $3 per gross ton to $6.20 to $6.80.

Minerals Separation, Ltd.

The eleventh annual ordinary general meeting of Minerals Separation, Ltd., was held in London in December, Francis L. Gibbs presiding. Among his remarks were the following:

"In our chairman's address to you last year, he expressed a hope that early in the current year our patent position in the United States would be so firmly established that the board would be able to recommend the payment of a substantial dividend. After exercising patience, in some cases for nearly 13 years, you will now receive your first reward if you sanction the distribution of trust certificates in the new North American corporation as proposed by the board. When Mr. Ballot addressed you last year, he estimated that during 1915 the licensees of our affiliated companies and of this company would treat over 4½ million tons of ore by our flotation process, and that during the current year (1916) the same licensees would treat over 13 million tons of ore by our flotation process. You will be glad to hear that the estimate of 4½ million tons for 1915 proved to be correct, and the figure of 13 million tons in 1916 will prove to be more like 14 million tons.

"I will now give you as much information as I have available as to the Minerals Separation North American Corporation, which is the full name of the corporation which has acquired the business of your American subsidiary syndicate. First, I will say that I have no doubt that the decision of the American syndicate to remove its domicile from London to the United States has your entire approval. This change has been contemplated for some time, and the growing business of the syndicate and the general adoption in the United States of our flotation process made it a necessity. It was becoming increasingly difficult to manage this American business effectively from London, and it was felt that a strong board in New York and a complete organization in the country where all the business was being conducted could not fail to be of great advantage. The chairman of the new corporation will be Mr. Ballot, and he will be assisted by Dr. Gregory and also by a partner in the New York house of Lazard Brothers & Co. There will also be voting trustees appointed, who will represent the shares for a period of five years. The reason that prompted the decision to have the new American corporation registered as a trust corporation was to insure that to whatever extent the 500,000 trust certificates representing the 500,000 shares of the new corporation (which have no face value) might change hands, the actual control of the corporation will remain with these trustees for that period of time. Mr. Ballot and Dr. Gregory will both act as trustees, and probably one other will also be appointed.

Under the agreement with the Anaconda Copper Mining Co., that company, combined with certain other companies, undertook to pay to us at least $300,000 whether the Supreme Court decided for us or against us. Now that the Supreme Court has heard our case and delivered judgment, it will interest you to know that the actual amount that we shall receive from the Anaconda company in respect of that contract up to the date of the Supreme Court judgment will be approximately $500,000.

It is, of course, difficult to form any estimate yet as to the value of our American business, but I hope that what I am now going to tell you will assist you to some extent to appraise its value. In the current year, if you take all our licenses together in the United States into account, they have treated in the aggregate roughly 11½ million tons of ore, from which the gross revenue will probably amount to about £140,000. It is estimated also—and please bear in mind that it is only an estimate—that the tonnage treated by the very numerous infringers of our process in plants actually in operation during the current year alone will also amount to 13½ million tons. Even if the rate of royalty charged on this latter tonnage were to be no larger than the rates which we have charged to those licensees who have loyally respected our patent rights, the gross annual revenue from plants already using our process in the United States would be not far short of £300,000. It is, however, unreasonable to suppose that those who in future will control our American interests will grant those who have been infringers of our process the same exceptionally favorable terms that were granted to large users like the Anaconda Copper Mining Co. before our patent position was established. We shall not, you may be sure, act otherwise than reasonably and equitably even toward infringers, but it is obvious that those who for the past three years have been making enormous profits by the unlawful use of our process must be prepared to hand over to us at least a considerable proportion of these profits. It is estimated that by means of our process these infringers have made profits of more than £5,000,000 beyond those which they could have made without our process, and by the American law we are, I believe, entitled to claim the whole of this excess. We anticipate also that not only large recoveries in cash will be obtained from the infringers of our process, but now that the patent question of the United States has been, we believe, finally settled by the highest court, it appears certain that a very large increase in tonnage treated under license will take place, and that the 25,000,000 tons treated this year will be greatly exceeded in future years.

Advantages Gained by Use of Flotation Process

While on the subject of this American part of our business, I should like to give you some striking information which will show you the immense advantage obtained by those who have adopted our methods of concentration on a large scale. The working of our flotation process has now arrived at such a pitch of perfection that in the case of large installations of our plant we are informed that the total operating cost per ton of ore treated is no higher than before the adoption of flotation, with the result that the whole of the extra recovery obtained by the use of our process in large installations is additional profit.

Examination of 15 Townships in Central Wisconsin to determine what indications of iron formation were present were made in 1916 by the Wisconsin Geological Survey. As many people are planning exploration for iron in the state, it has been found advisable to issue information regarding these townships in advance of the publication of the printed report. Accordingly, blueprints were prepared showing each of the 15 townships with the magnetic lines, roads, streams, etc. These blueprints were ready for distribution about Jan. 1, 1917. The townships covered lie in Jackson and Monroe Counties and include the following: Township 19 N, Range 1 E; township 20 N, Range 1 E, 1 and 2 W; township 21 N, Ranges 1 E, 1, 2, 3 and 4 W; township 22 N, Ranges 1 E, 1, 2, 3 and 4 W; township 23 N, Range 4 W. These blueprints will be sold at the cost of making them. A single map may be obtained for 5c., or the entire set for 75c., from W. O. Hotchkiss, state geologist, at Madison, Wis.

Filing Survey Data at Mines—II

By R. S. Schultz, Jr.*

SYNOPSIS—A routine of drafting-room procedure is suggested and the advantages and disadvantages of different methods of filing loose-sheet material are outlined. Special attention is given to the separation of home drawings and foreign drawings. Importance of careful indexing and protection against fire strongly emphasized.

When a new drawing is to be made, the chief engineer gives the necessary instructions to the draftsman, together with the title and the drawing number. As he does this, the chief engineer fills in the drawing-record card shown in Fig. 7 and places it in a suitable file until such time as the finished drawing shall come to him for approval. He also enters the title in a consecutive-number record, usually kept in a small notebook or on 3x5-in. index cards, which is intended for his reference only, to make duplication of numbers impossible.

The draftsman enters the title and number of the drawing in ink on the detail paper and proceeds on the work. When the tracing is started, the title is filled in first, including the initials of the maker and the tracer. The tracing completed, the drawing passes to the checker, who enters his initials after thorough checking and passes it to the chief engineer for his approval. On approving the drawing, the chief engineer affixes his initials. He then removes the drawing-record card from his file and enters on it the names of all persons or firms to receive prints together with the number to be sent to each. He then attaches the card to the tracing and sends both to the file clerk. The latter, in turn, has the necessary prints made, places one in the files and distributes the others as directed, entering the date of sending on the record card, which is immediately filed.

In the case of alterations or additions made to the original tracing, practically the same procedure is carried out. The record card is withdrawn from the files and goes with the tracing to the chief engineer, who gives the necessary instructions to the draftsman and enters the nature of the changes on the record card, which he then files as with a new drawing. The draftsman enters the changes in the table of changes and completes the work. The drawing then passes through the hands of the tracer and the checker to the chief engineer. He approves it, attaches the card filled out as before, and sends both to the file clerk, who has the necessary prints made, stamps the issue number in the proper place in the title and sends the reissued prints to the proper parties.

The drawing-record card, already referred to and shown in Fig. 7, is intended as a complete record of the drawing. It is used primarily as a consecutive-number index card, but is much more. It shows that drawing 1076 is of the "details of automatic stop for 24x48-in. hoisting engine at shaft No. 5." It is filed in file 2, drawer 3. It was started June 21, 1914, by C. H. It was traced June 25, 1914, by T. H. C. and was checked June 28, 1914, by W. K. T. It was approved June 28, 1914, by C. B., and prints were sent the same day to the power department, to the machine shop and to the Kansas City Foundry Co. and the Denver Machinery Co., probably for bids. On July 2, 1914, pattern 1076-B was replaced by a new design, pattern 1076-H, which was drawn by C. H., traced by K. I. B., checked by W. K. T. and approved by C. B., all on the same day. Prints were sent out July 3 to the same parties as before. The original issue prints sent to the power department and machine shop were returned the same day, but those sent to outside parties were not returned until the 7th and 9th of the month. This print record is of especial value in showing whether a department or firm has the latest prints and whether prints from previous issues have been returned.

8″ × 5″

Title: Details of Automatic Stop—24″x48″ Hoisting Engine — Drawing No. 1076
Shaft No. 5 — File No. 2
Scale: ¼″ and ½″ = 1″ — Drawer No. 3

Issue No.	Original		No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7	
Description of Alteration			Casting 1076-B Replaced by Casting 1076-H													
Drawn By:	G.H.	6/21/'14	C.H.	7/2/'14												
Traced By:	T.H.C.	6/25/'14	K.T.B.	7/2/'14												
Checked By:	W.K.T.	6/28/'14	W.K.T.	7/2/'14												
Approved By:	C.B.	6/28/'14	C.B.	7/2/'14												
Sent to:	Sent	Ret.	Sent	Ret.	Sent	Ret.	Sent	Ret.	Sent	Ret.	Sent	Ret.	Sent	Ret.	Sent	Ret.
Power Department	6/28/'14	7/3/'14	7/3/'14													
Machine Shop	6/28/'14	7/3/'14	7/3/'14													
Kansas City Foundry Co.	6/28/'14	7/7/'14	7/3/'14													
Denver Mach'y Co.	6/28/'14	7/9/'14	7/3/'14													

Copper Mining Co.
Drawing Record Card

FIG. 7. CARD FORM USED FOR RECORD OF DRAWINGS

Three Methods of Filing Described

There are three well-recognized methods of filing loose-sheet material—folded, rolled and flat. Each has certain advantages.

First: Folded to suitable size for filing in document, letter or similar files. This method requires material that

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will not be injured by folding. It is adapted to a wide variation in size, but the material should be thin enough and small enough to fold into the required size without becoming too bulky. The advantages are that material is filed with a minimum of waste space, filing equipment requires minimum floor space, uniform size of material is unimportant, excellent classification is possible in medium-sized units, first cost of filing equipment is low, expansion is possible in small units at a minimum cost and that material should never be lost except through gross carelessness. The disadvantages are that material must be folded for filing and unfolded for even momentary reference, material must be marked and numbered before filing (with possibility of error), errors in filing are difficult to trace, method cannot be used for material that will be injured by folding and that material must be creased for filing, with possible obliteration of important figures and with increased possibility of tearing.

Second: Rolled, to be filed in suitable drawers, pigeonholes or containers. This method is adapted to material of unusually large size which will be seriously injured by folding. It is especially suited to mounted drawings, unusually large tracings, or long rolls such as hydrographs. The advantages are that the method is adapted to a great range in size and in material, material is largely self-protected from the effects of dust and light, filing is

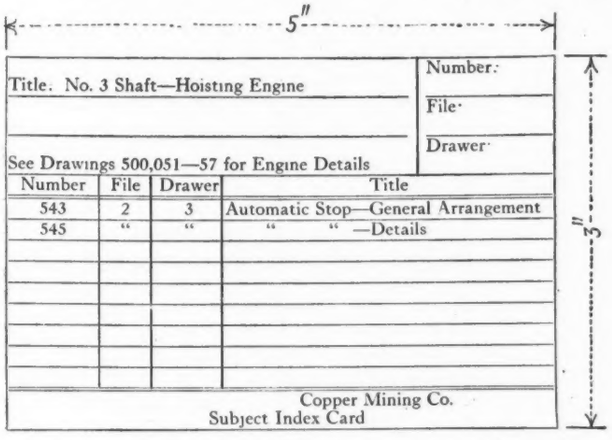

FIG. 8. SUBJECT INDEX CARD FOR DRAWINGS

in single or small units (permitting exceptional classification) and that material may be removed from the files without handling remaining rolls. The disadvantages are that material must be rolled for filing and unrolled for reference and is hard to handle if tightly rolled, the method is not adapted to filing large quantities of material, it gives a minimum filing capacity in a maximum of floor space and it requires special cabinets or containers.

Third: Flat, for filing in suitable files or drawers. This method can be used for practically all forms and classes of material, limited only by the size of the filing devices. It is especially suitable for medium- or small-sized material occurring in considerable quantity. The advantages of this method are that material is filed without additional marking, stamping or folding, material can be referred to quickly for either identification or momentary reference without removal from the files, excellent classification in large units is possible, mistakes in filing are instantly recognized and easily corrected, material is ready for immediate reference on removal from the files, and that injury due to folding or creasing is improbable. The disadvantages are that filing cabinets require large floor space (not necessarily true with vertical files instead of drawers), the first cost of filing cabinets is large, expansion is possible only in relatively large units at considerable expense, uniformity in size of material is very desirable, the method leaves considerable waste space even under the most favorable conditions, and that in overcrowded drawers material may be torn in removal or lost by being pushed back in the files.

These three arrangements indicate the usual methods adopted for filing drawings and similar material. The choice will depend largely on the amount of material to be filed, its size, the frequency with which it will be used for reference and the amount of money available for the purchase of fixtures.

Filing Methods for "Home Drawings"

The two general subdivisions of home drawings have already been indicated. The subdivision of maps and other paper drawings is of maximum importance at a mine, since maps are essential to efficient operation. The drawings to be filed under this class vary from very large to very small; they differ in material, in importance and in frequency of use. Many of them, especially maps, are for final reference purposes only and will be handled at relatively infrequent intervals. They require careful preservation and should be protected as far as possible from the injurious effects of light and dust. Filing in rolls is the most satisfactory method for disposing of this class of material, and where possible, a special cabinet of pigeonholes should be obtained for the rolls. The length of such a cabinet should be determined by the width of the largest map which will probably be filed in it, about 6 ft. being a usual length. The pigeonholes should vary in size from about 1 in. square for tracings or other material easily rolled, to about 6 in. square for large mounted maps. The cabinet should have doors at each end to permit better use of the available space. Cardboard or tin tubes are an excellent addition to such a cabinet and should be provided for all important maps. As far as possible, only one drawing should be filed in a roll. Extra-length tracings, as provided under "home drawings—tracings," should be filed with this material in the smallest-sized pigeon holes.

The two headings under the subdivision tracings and blueprints will usually, and should always, be filed separately. For tracings the injury due to folding prevents the use of that method of filing, while the quantity of material to be filed will prevent the use of the roll method in all but the smallest offices. Flat filing, either horizontal or vertical, is therefore almost imperative. I prefer to file tracings in drawers of suitable size, owing to the difficulty of keeping the tracings flat when filed vertically. Where drawers are used, the sheets should be filed in consecutive order with the latest number on top. Full-length and half-length sheets should be filed in separate drawers. Shallow drawers are recommended, since with deep ones there is the possibility of the drawer becoming so overcrowded that the lower tracings may be torn in trying to remove them.

Filing Blueprints and Indexing

For blueprints the quantity to be filed prevents the use of the roll method and the choice between folded and flat filing will depend very largely on local conditions. Half a dozen vertical document files costing about a dollar each,

in a case made in the mine carpenter shop, will provide ample capacity for several hundred prints at a minimum cost, and expansion can be gradual and equally inexpensive. At a small mine, especially during the prospecting stage, where prints are few and are referred to at comparatively infrequent intervals, where rapid reference is unnecessary and folding and unfolding are not a burden, such a document-file system will prove entirely satisfactory. In a large office, with thousands of prints on file, where a number of engineers and draftsmen are constantly employed and many prints referred to daily, rapid reference and identification become necessary and flat filing in drawers or in vertical cabinets becomes essential to the most efficient work.

In the average case, between these two extremes, the choice will depend on the money available and on personal preference. Where the greater expense is at all warranted, I prefer flat filing in drawers for "home" prints. The drawers should be roughly classified, each being reserved for a certain subject—for example, hoists in one, pumps in a second, drills in a third, and so on—thus making it easy to locate any general group of prints without reference to the index. As with tracings, shallow drawers are recommended, and they should never be allowed to become overcrowded. A ½-in. round bar, fitted in slots at the sides of the drawer near the front, will greatly increase the capacity and will prevent the prints from catching as the drawer is opened. The reference files should contain but one print of each drawing, and this should show the latest information available. It should be distinctly marked "office copy," and its removal from the office should be prohibited.

It is the practice in some offices to preserve one print from each issue, usually fastened along one edge to prints of later issues. In my opinion, this is unnecessary if the method of alteration shown in Fig. 5 is adopted. The original, as well as the superseding figures, are plainly shown and reference to but one print is necessary to show the entire evolution of the drawing. It may be argued that alterations made in this way seriously impair the appearance of the drawings, but drawings are usually made for efficient use instead of looks and any operation tending to fill the files unnecessarily would seem to be inefficient. Where alterations other than dimension alterations are necessary, the superseded lines are hatched out and the new lines drawn in. Where dimension alterations make scaling entirely inaccurate, the drawing should be marked to that effect. It is poor practice to permit scaling, except of maps, because a drawing which does not show all necessary dimensions is incomplete and no draftsman can be held responsible for variations in printing papers. To prevent this practice, each print should be stamped, "Do not scale this drawing; use figures only." Should any drawing be altered so frequently as to make its reading difficult, a new drawing, distinctly marked "Supersedes sheet of same number dated ——," should be made to cover the latest design. The superseded tracing should then be marked, "Superseded by sheet of same number dated ——," and filed for reference, but no prints need be preserved.

If the folding method of filing be adopted, all prints should be folded to approximately the same size. A folding templet, of either brass or steel, will be a great convenience. Where vertical document files are used, more accurate classification by subjects may be obtained, as compared to filing in drawers, owing to the reduced capacity of the separate filing units. With vertical letter files used without subdivision guides, this advantage does not exist, since such a file will usually hold more prints than a drawer. For vertical filing the print should be folded with the back out and with a form showing the drawing, case, file and issue numbers stamped in the upper right-hand corner and filled out before filing. These data, together with those on the index cards, will show all the necessary general information regarding the print without unfolding.

Two separate card indexes are required by this system of filing—a consecutive number index and a subject index. The 5x8-in. drawing-record card (Fig. 7) is used as the consecutive-number index card and shows the complete history of the drawing, including by whom made and handled and to whom sent and when, etc.

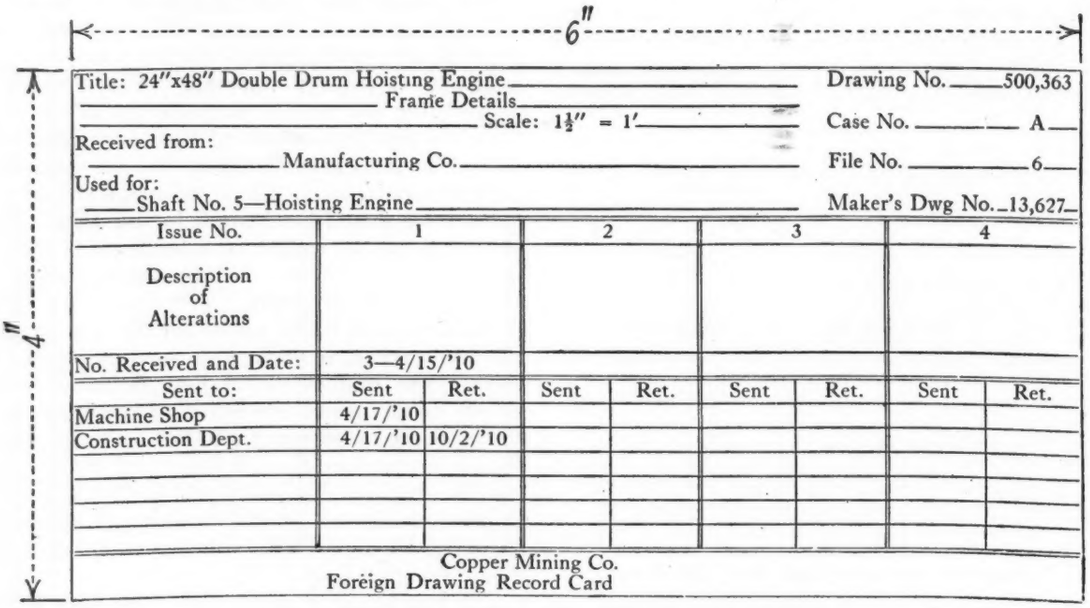

FIG. 9. RECORD CARD FOR FOREIGN DRAWINGS

The 3x5-in. card shown in Fig. 8 is used for the subject index. Aside from the title and the drawing, file and drawer numbers, it contains no information regarding the drawing itself, all such information being shown on the consecutive-number index card. The subject-index card may be used in two ways—either as a classified index as shown in the example, or as a single-drawing index using the bottom of the card for cross-references. By either use it answers the double purpose of a subject index and a cross-reference index, greatly facilitating the finding of related prints.

With these two indexes, properly kept up to date, any drawing on file may be found readily by either number or subject. The subject-index file should be guided and subguided, using much the same system of subdivision as shown for survey notes in Fig. 1. Where prints are classified in drawers or files according to subject, a subject index may seem superfluous, but it will prove to be a great time saver. It is a very poor subject index that will not much more than pay for itself.

How To File Foreign Drawings

The term "foreign drawings" is used to designate all blueprints and similar material, obtained from sources other than the company, that come to the engineering department for classification and filing. The wide range in subjects and the difference in character, size and material make these data difficult to file satisfactorily.

One great essential in filing foreign drawings is to keep this material distinct and separate from home drawings. This result may be accomplished by distinct marking to designate foreign origin, by separate filing arrangements, by index and file numbers distinct from those for home material; and by using index cards of different color.

In a general way, the system of filing outlined for home blueprints may be employed to advantage for foreign drawings as well. Simple filing and double indexing, by number and by subject, are the elements of the system. All foreign drawings should be distinctly marked "Foreign." This is usually done with a large-letter rubber stamp in at least one prominent place on each copy. With such a stamp on both the face and back of a drawing there can be little excuse for confusion.

Widely varying index and file numbers will further reduce the possibility of confusion, affecting not only the drawing but all index cards as well. Drawing numbers in the hundreds of thousands as against hundreds and thousands for home drawings and letters instead of numbers for the cases and files will make this means of separation quickly apparent.

The advantages of the various methods of filing have been discussed already. Two of the reasons—uniformity of size and frequent reference—advanced for the choice of flat filing in drawers for home drawings do not apply to foreign drawings. Uniformity of size is impossible with any amount of material to be filed, and any attempt to secure it for flat filing will be a failure and a waste of time. Foreign drawings will not be referred to with the same frequency as home drawings, except over short, irregular periods. For these reasons the greatest objections to folding disappear, while its advantages are accentuated; and folded vertical filing in either letter files or document files is recommended for foreign material. I prefer document files because they are smaller units permitting better classification, are fully as easy to handle, and are considerably cheaper unless bought in large and elaborate cabinets.

The fourth means of distinguishing foreign from home drawings applies to the index cards only. A different color, distinct in artificial as well as natural light, should be used; and whatever color is selected should be used for all cards covering foreign drawings.

The card used in the consecutive index for foreign drawings is 4x6 in. and is similar in form and in use to the one used for home drawings. The subject-index card for foreign drawings differs in color only from the card for home drawings. Cross-reference between these two classes of drawings is possible without confusion when the large difference in drawing numbers is used. An example is shown in the table of references, Fig. 4.

A foreign drawing on its receipt is examined by the chief engineer, who, before passing it on to the file clerk, determines the consecutive number from his records and fills in all information, not obtainable from the drawing itself, required by the foreign-drawing index card, Fig. 9. The drawing, with index card attached, passes to the file clerk, who stamps the date, a form showing the drawing, case, file and issue number, and "Foreign" on the face of each copy received and "Office copy" on that selected for the files. He then fills in the drawing number and the case and file letters on the face of each drawing, folds the prints to the proper size and repeats the numbers and letters in the upper right-hand corner. He finishes filling in the index cards, files the office copy and the cards, and sends the copies for distribution to the proper parties.

The Use of "Foreign" Drawings

Should reissued prints of foreign drawings be received they are handled in exactly the same way. The new prints are sent to the proper parties and the old prints collected, as far as possible, and either returned to the maker or destroyed. Should any marked alterations in design be shown, it is usual to retain the office copy of each previous issue for reference. These prints, distinctly marked "Superseded," should be fastened to the print in force, so that a complete record may be preserved without confusion. This applies to foreign drawings only.

The great value of foreign drawings, especially to the drafting room, is often overlooked or underestimated. Makers' drawings of engines and similar machinery are especially valuable. These drawings are of great assistance to the engineer and draftsman when repairs are necessary or alterations desirable. They frequently show dimensions and details which otherwise could be obtained only after considerable field work, and even then might not be absolutely accurate. A serious effort should be made to secure working drawings of all new installations at the time of purchase. It is the excellent practice of a number of firms to require a full set of such drawings to be furnished as part of the contract. Most manufacturers willingly furnish such a set of prints, usually under a provision that they shall not be used for reproduction, except as required for repairs.

Keeping Account of Tracings and Prints

No difficulty should ever be experienced in keeping track of tracings, since they should never be removed from the drafting or printing rooms. Responsibility for tracings cannot pass beyond four men—the file clerk, the draftsman, the checker and the chief engineer. The file clerk responsible for the tracing as long as it is in

the files, passes that responsibility to the chief engineer when the tracing is removed for alterations or additions. The chief engineer, in turn, passes the tracing and part of the responsibility to the draftsman, but retains the drawing-record card until such time as the changes have been completed and checked and the tracing returned to him for approval. His records should always show which tracings are out of the files as well as what new drawings are incomplete.

Less formality will usually be exercised with prints, and in all but very large offices a rule that the office copy shall never be taken from the office will prevent loss. In large offices employing a number of engineers and draftsmen, some form of receipt will be necessary for all prints removed from the files, even for office use. This receipt should be placed in a pocket in the drawer or case so that the exact location of each print can be readily determined.

The value of the material filed in the engineering department and drafting room is seldom realized in connection with the possibility of loss by fire. Thousands of dollars' worth of instruments, fixtures and records, many of which cannot possibly be replaced are frequently filed in buildings having very little fire resistance or protection. With this fact in view, a fireproof vault should be provided for the engineering department if possible, and the original records or accurate copies should be filed therein. Where separate records are made for fire files, their character should be noted plainly on the face of all drawings and cards and under no condition should the use of these records be permitted outside of the vault. A fire vault is a very cheap form of insurance.

Addition to Engineering Societies Building

The American Society of Civil Engineers has finally decided to join the other engineering societies in the headquarters building at 25 West 39th St., New York. This, coupled with the need of greater library capacity, caused a committee of the joint societies to decide on the necessity of a three-story addition to the present 12-story building. While preliminary negotiations between the several societies were going on, the city authorities announced the early enactment of an ordinance limiting the height of buildings, which would have made the projected addition to the building to accommodate the American Society of Civil Engineers impossible. In addition to this the ever-rising cost of materials made estimates unreliable and an early consummation of contracts advisable. By good management on the part of the committee, the necessary plans were filed before the building ordinance went into effect and favorable contracts were let with the constructors of the original building. In *Engineering News,* Jan. 11, 1917, a description is given of the architectural and structural details, from which the following notes are taken.

The top of the present building is occupied by the large joint library, housed in a hall spanned by trusses carrying the roof. The three-story addition is to be placed directly over the library, starting from the level of the present ceiling, just below the roof trusses.

The æsthetic phase of the problem was very difficult. The exterior architecture of the old building was strictly proportioned to the original height, and the development of its upper part appeared to preclude the possibility of building over it with satisfactory æsthetic effect. After making numerous studies, however, it appeared that the very restrictions imposed by the structural conditions afforded a happy solution of the æsthetic problem. The truss framing that had to be used to carry the new load made it virtually necessary to set back the walls of the added stories. This arrangement suggested a penthouse or tower effect, and on working this out in due proportion to the old building, a satisfactory result was secured. Elevator service to the new floors will be obtained by extending the three present elevator shafts up to the new roof. Incidentally, new machines will be fitted, traction elevators replacing the present drum machines. The work will require about 686 tons of steel.

Stockholders Resume Operation of Ohio Copper

Stockholders have redeemed the Ohio copper mine in the Bingham district in Utah and, under the title of the Ohio Copper Co. of Utah, resumed the operation of the property on Jan. 1, 1917, with Alfred Frank as general manager. Mr. Frank has been at the head of the leasing company operating the property profitably for over a year, under the title of the General Exploration Co.

From 2000 to 2500 tons of 1% ore are being mined daily and treated in the mill at Lark, Utah, where an extraction of 45 to 50% is attained. Orders have recently been placed for an initial flotation unit of 200 tons capacity, which is expected to bring the extraction up to 80% or over. Minerals Separation machines will be used and after the success of the first unit is established, the flotation department will be gradually increased to the capacity of the rest of the mill. It is also expected that the application of flotation will make it practicable to treat ore having a tenor of less than 1% copper, of which there is a considerable amount. The eventual treatment of the accumulated tailings has likewise been under consideration.

The Ohio Copper Co. of Utah has now $300,000 cash available, and 500,000 shares in the treasury; 2,000,000 shares of the company are outstanding. The officers are Hubert E. Rogers, president; Edwin S. Hooley and Charles A. Kittle, vice-presidents; Samuel K. Kellock is secretary and treasurer, with offices at 43 Exchange Place, New York.

School for Officers of Engineer Reserve Corps

A course of instruction for members and prospective members of the Engineer Officers' Reserve Corps, which is the direct outcome of the work initiated by the national engineering societies a year ago, has been started by the inauguration of evening drills held at the armory of the 22d Corps of Engineers, New York City.

The course will include military calisthenics, infantry drill, engineer drill, and a series of problems in both infantry and engineer duties, for which written solutions will be required. The problems will be supplemented by short talks and the explanation and discussion of approved solutions. Throughout the course the methods of instruction used at the United States Military Academy, West Point, will be followed.

Openpit Steam-Shovel Costs

By J. M. Anderson*

Operating costs are controlled almost entirely by two distinct factors; namely, mechanical operation and human temperament. As concerns the latter, it need only be mentioned in passing that in recent years social engineering has proved almost as important as civil engineering. This article, however, is limited to the consideration of the factor of mechanical operation.

Two years ago the writer was engaged with one of the largest of the so-called porphyry copper mining companies of the Southwest. The method of analyzing the operating costs of the steam-shovel mining department is graphically shown by Fig. 1. In this chart it

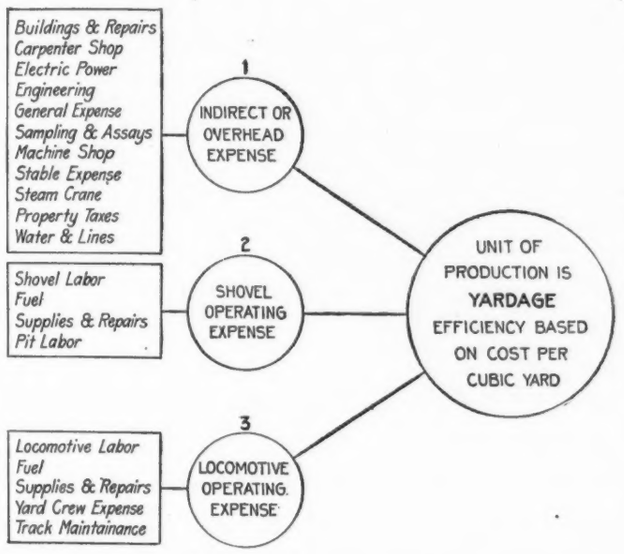

FIG. 1. STEAM-SHOVEL COST DISTRIBUTION CHART

will be noticed that the operating costs are classified under indirect or overhead expense, shovel-operating expense and locomotive-operating expense. It was desired to place before the executive company officials, superintendents and foremen the results of their efforts from a cost standpoint. In order to avoid danger of confusing them with mere columns of figures arranged for an auditor's convenience, the graphical-chart method was adopted, as shown in Figs. 2, 3 and 4.

These cost-curve charts were prepared to show the effect of varying daily production on cost. The charts are entirely self-explanatory, and by their use a daily unit cost of production can be figured to a fraction of a cent.

For illustration of the use of the charts, assume that six steam shovels, each operating two shifts, handle in 24 hr. a total of 12,000 cu.yd. of rock, or an average of 1,000 cu.yd. per shovel shift. By referring to Fig. 2 we find from the coördinates of the double-shift curve that the overhead expense for production at this rate is $0.072 per cu.yd. This cost chart is based upon the total overhead cost for six shovels per single-shift month of $14,217.98, or $25,645.66 per double-shift month with corresponding costs of $473.93 per single-shift and $854.85 per double-shift day. The items aggregating into these totals are shown in the accompanying table giving the overhead costs of steam-shovel operation. The component factors are expressed in percentage of single and double shifts.

STEAM-SHOVEL OVERHEAD COSTS

	Single Shift, %	Double Shift, %
Water and water lines	2.63	8.20
Building repairs	3.50	7.34
General expense	63.00	59.80
Stable expense	2.74	2.20
Machine shop	9.60	7.17
Electric power	4.43	2.18
Engineering and surveying	4.27	3.40
Sampling and assaying	1.62	3.77
Steam-crane expense	2.64	2.34
Carpenter shop	0.40	0.26
Property taxes	5.22	3.34
	100.00	100.00

To continue the illustration, the operating cost is found from the chart, Fig. 3. At the average rate of production of 1,000 cu.yd. per day, the cost per yard is $0.051. This cost curve is based on the average cost per steam-shovel shift for the entire year 1914, during which a total of 4,617 shifts were worked at costs shown as follows:

STEAM-SHOVEL OPERATING COSTS

Item	Total Cost	Cost per Shift
Shovel labor	$64,868.57	$14.05
Fuel	65,941.92	14.28
Supplies and repairs	55,258.73	11.96
Pit labor	51,523.68	11.16
	$237,592.90	$51.45

In addition to the overhead and operating costs must be charged the cost of locomotive service per steam-shovel shift. On the assumption that the locomotives are required to serve one steam shovel digging 1,000 yd. per

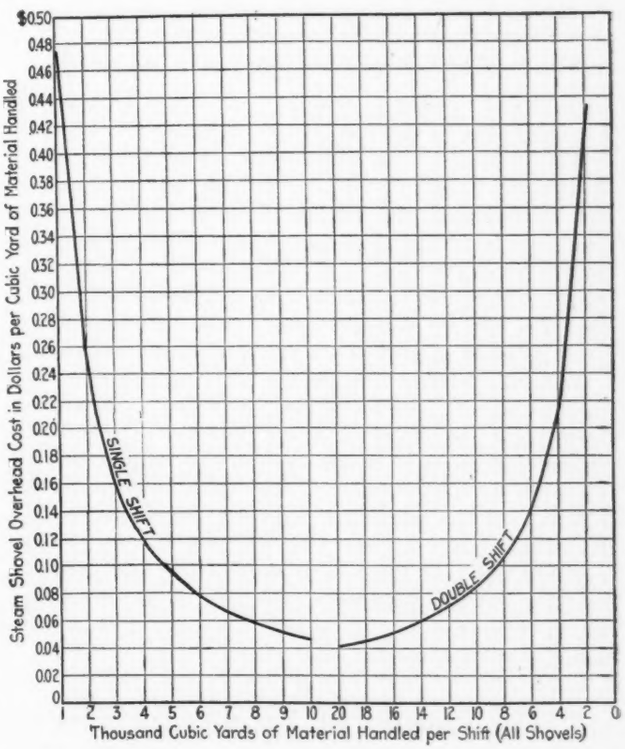

FIG. 2. STEAM-SHOVEL OVERHEAD COST CHART

day, from the chart of Fig. 4 it is seen that the cost of this service is $0.084 per yard of material handled. This chart is based upon average costs for the entire year 1914, which include all accounts chargeable to

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transportation shown in the next tabulation which is based on the 9-hr. shift as a unit.

LOCOMOTIVE COST PER SHOVEL SHIFT

	Per 9-Hr. Shift
Locomotive labor	$11.28
Fuel	14.30
Supplies and repairs	3.83
Yard crew expense	.88
Track maintenance	11.42
Total cost of one locomotive	$41.71
Cost of two locomotives	83.42
Cost of two and one-half locomotives	104.27

In summary then, the complete cost per yard handled in the case taken for illustration is as follows: Overhead, $0.072; operating, $0.051; locomotive service, $0.084; total, $0.207. Neither blasting nor dumping expense is included in the foregoing, as they naturally have a wide cost variation.

Now if it is kept in mind that each one of these cost curves covers a multitude of items and that such matters as ratio of equipment—locomotives per shovel, dump cars per locomotive, etc.—may seriously affect the yardage output, it can readily be seen how a daily graphic repre-

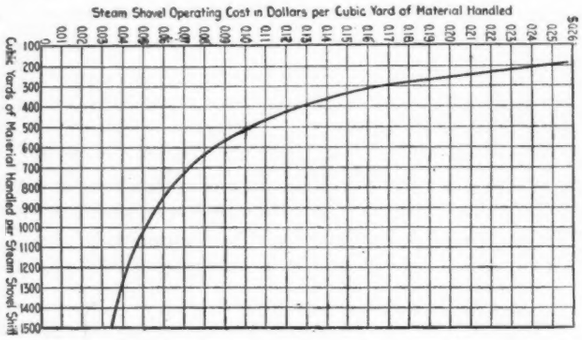
Steam Shovel Operating Cost in Dollars per Cubic Yard of Material Handled
Cubic Yards of Material Handled per Steam Shovel Shift

FIG. 3. STEAM-SHOVEL OPERATING COST CHART

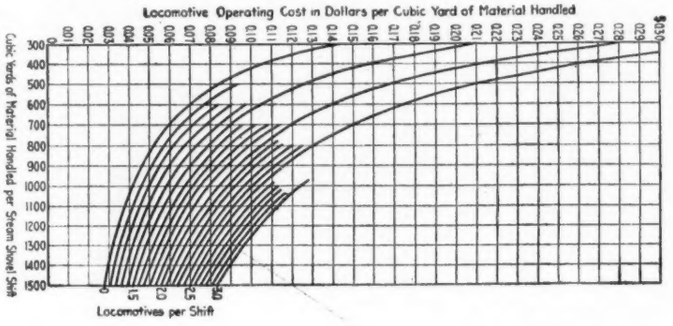
Locomotive Operating Cost in Dollars per Cubic Yard of Material Handled
Cubic Yards of Material Handled per Steam Shovel Shift
Locomotives per Shift

FIG. 4. LOCOMOTIVE OPERATING COST CHART

sentation of operating results will tend to affect the human factor in the scheme of operation.

For instance, if for any reason one of the six shovels is laid up a day for repairs so that the production is only 10,000 tons, the average overhead expense per yard produced is thereby increased from the before-mentioned $0.072 to $0.083 per yard. This fact is so quickly and plainly illustrated to the foremen by the use of the chart that the desired salutary effect is easily obtained and great effort is made to keep all equipment in operation.

With the enormous overhead costs necessary to carry in this day of large operations, it is easy to obscure the finer points of efficiency from the eyes of entirely responsible foremen. By the use of such charts, however, they are no longer kept in the dark concerning their results. At the particular property under consideration, for instance, it was found that the greatest possible yardage, did not give the lowest possible cost per yard. By carrying out this plan with variations, it was determined which were the best practical methods of work from actual performances and cost results.

Tin Output of Southern China

The principal tin mines in southern China are in the Kotchiu district, province of Yunnan, according to a report made by Vice-Counsul P. R. Josselyn, of Canton, China, to the Department of Commerce, Washington, D. C. The annual output of that section is between 6000 and 7000 tons of tin, removed entirely by native methods. The proportion of tin in surface ore is from 0.1 to 0.4%. This comprises about three-tenths of the whole Kotchiu output, and because of the poor grade it requires a large supply of water for washing. The rainy season rarely lasts more than three months, and for lack of artificial means of conserving the water supply, surface ore can be worked with a profit only four or five months in the year.

The native process of washing this low-grade ore is somewhat similar to the modern hydraulic method. Trenches are dug before the time for the big rains. The average ditch is from one-third of a mile to a mile in length, with sufficient slope to cause a gentle pressure. As a result of the first washing the ore represents 5 to 40% tin. The shaft ore runs from 2 to 20% tin. Since this ore requires much less water, it furnishes a branch of the industry which may be carried on for six months in the year.

The Yunnan Tin Trading Co. conducts a modern ore-dressing plant and smelting works at Kotchiu. The smelting works cast the ingot in the iron mold, analyze, and sell according to purity, but they also conform to the peculiar Chinese practice of casting in sand molds. The ingot cast in the sand mold is not sold upon analysis, but the surface indications of the ingot form the basis upon which the purchase is made. The works of the Yunnan Tin Trading Co. have been in operation for about five years. The plant employs about 100 men, with a graduate of an American university as engineer-in-chief.

The bulk of the tin for export from this source is shipped at Kotchiu, through the port of Mengtsz, to Hongkong, whence it is reëxported to the United States and Europe. There are no exports of tin direct from Canton to the United States.

Swiss Aluminum Industry

The Swiss aluminum company, which has large plants at Neuhausen, near Schaffhausen, Switzerland, where it utilizes a part of the hydro-electric power from the Rhine, in Baden, distributed dividends of 20% in 1915, according to *Revista Minera*. The *Elektrotechnische Zeitschrift*, of Berlin, publishes a review of the report of the company, treating of its relations with France and Germany. According to this, since the beginning of the war the product has been sold principally to Germany and its allies, because the raw materials come entirely from those countries. The same policy might have been carried out with France, but a suggestion to that effect was refused, on account, it is believed, of the influence of French competitors.

Flotation of Stibnite Ores

By Joseph Daniels* and C. R. Corey*

SYNOPSIS—The flotation of ores containing antimony as the metal of principal value has not received much public attention, but the experiments carried on with ores from Alaska indicate that it is commercially possible. A Case-type laboratory machine was used, and the most satisfactory process was found to require the use of small amounts of sulphuric acid and creosote oils.

The flotation of antimony ores has received comparatively little notice in the technical press, either because little work has been done along this line or because results have not been available for general information. Hoover[1] refers to antimony in the following statement: "Such minerals as antimony or molybdenum sulphides, which because of their friable nature suffer prohibitive losses in water concentration, are found amenable to treatment by the Elmore process."

An earlier reference in the *Engineering and Mining Journal*[2] is as follows: "We are informed that tests of the Elmore oil-concentration process on gold-bearing antimony ores have recently been made with very successful results. It is well known that antimony sulphide ores are very difficult material for concentration by ordinary methods, and that the treatment of such minerals carrying gold in Nova Scotia, Australia, Portugal and Austria has been wasteful and unsatisfactory."

Henry E. Wood, in 1912,[3] refers to tests made by him and gives the first statement of results on an antimony ore:

TESTS ON ANTIMONY ORE (STIBNITE)

	Sb, %	Recovery, %
Crude, 100% by weight at 40-mesh	3.57	
Flotation concentrates, 6.50% by weight	47.40	86.30

Following the publication of these results, Donald G. Campbell[4] published the results of a study of oil flotation on an antimonial silver ore.

The investigation discussed in this article was undertaken at the College of Mines, University of Washington, by the authors to determine whether low-grade Alaskan stibnite ore could be successfully concentrated to a product high enough in antimony to warrant the installation of a flotation plant. Paralleling this problem, a similar investigation was made on a gold-bearing antimony ore from the Nome district, Alaska. Partial results of the latter investigation were recently published.[5] The significance of these tests is discussed in a later part of this article.

The ore tested in this investigation is a stibnite from the Fairbanks district, Alaska. The mineral occurs in lodes in a country rock of mica schist or quartz schist,[6] which has been extensively fractured. The stibnite is found along the shear zones in kidneys and shoots and is associated with some accessory quartz. The mineral is finely granular and shows some oxidation phases that are red in color. This may be kermesite (Sb_2S_2O).

The high price of antimony during 1914 and 1915 has led to the development of some of the Alaskan deposits. Brooks[7] states that the shipments in 1915 from six mines were 833 short tons, valued at about $74,000. The ore averaged 58% antimony. Of the six mines, four were in the Fairbanks district and two in the Nome district. The operations in the Fairbanks district were, however, on a small scale. Most of the ore was broken and concentrated by hand-sorting, and no ore carrying less than 50% antimony was shipped.

The sample of ore submitted for tests represented waste dump material, too low in grade to ship. It consisted of stibnite with some red antimony mineral, probably kermesite, in a schist gangue, which also carried quartz.

Analysis of the original sample is shown in the accompanying table:

ANALYSIS OF THE ANTIMONY ORE

Antimony	35.0%
Insoluble	41.2%
Sulphur	15.0% (estimated)
Arsenic	0.1%
Gold	0.14 oz.
Silver	2.00 oz.

The problem given to us to solve was the enrichment of the antimony content without regard to the gold or silver values.

All the tests were run in a Case laboratory machine which was operated at various speeds from 1200 to 2000 r.p.m. At 1400 r.p.m. the peripheral speed was 1190 ft.; at 1500 r.p.m. the peripheral speed was 1275 ft. Twelve hundred ft. per min. was decided to be the best speed, and the machine was run in the final tests at 1400 to 1500 r.p.m.

In the first tests the material used was ground to pass a 65-mesh Tyler standard screen with an opening of 0.0082 in. The tailings carried visible mineral grains, and the next samples were ground to pass 80-mesh, opening 0.0069 in. These tests did not show a great improvement. To observe the effect of still finer grinding, an original sample of 80-mesh material was screened and a sample of the oversize on the 100-, 150- and 200-mesh screens taken for test (experiments Nos. 28, 29 30). The +200-mesh material gave excellent results. This was confirmed by a subsequent test (No. 33) in which a special sample was ground in a pebble mill to pass 150-mesh. For practical purposes, however, it was thought best to grind the material to pass 100-mesh (opening 0.0058 in.); all the later tests were made on this size.

Pulp densities of 1:4, 1:5 and 1:6 were tried. The 1:5 ratio of ore to water was selected, and the final tests were made on a mixture of 500 grams of ore and 2500 c.c. of water.

Temperatures varying from 10° C. (50° F.) to 30° C. (86° F.) were employed. Warming the mixture by steam to an average temperature of 26° C. (78.8° F.) was found to give the most satisfactory results.

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[1]Hoover, "Concentrating Ores by Flotation," 1912 edition.

[2]Vol. 70, Nov. 3, 1900, p. 515.

[3]Henry E. Wood, "The Wood Flotation Process," "Bull. A. I. M. E.," November, 1912, pp. 1227-44; "Trans. A. I. M. E.," Vol. 44, pp. 684-701.

[4]D. G. Campbell, "A Study of Oil Flotation," School of Mines Quarterly, Vol. XXV, No. 1, November, 1913, pp. 28-34.

[5]"Flotation Tests on an Antimony-Gold Ore," Earl R. Pilgrim, "Eng. and Min. Journ.," Vol. 102, No. 19, Nov. 4, 1916, p. 820.

[6]"Antimony Deposits of Alaska," A. H. Brooks, U. S. Geol. Sur. Bull. 649, 1916.

[7]A. H. Brooks, "The Alaska Mining Industry in 1915," U. S. Geol. Sur. Bull. 642-A, 1916, pp. 29-30.

The time of agitation varied from 10 to 30 minutes; 15 minutes proved to be sufficient to bring up most of the froth, and any excess time gave very little increase of concentrate.

The use of sulphuric acid was found to be necessary with the oils employed. Concentrated H_2SO_4 (specific gravity, 1.84) in quantity equal to 0.44% of the weight of the ore was finally adopted as the standard.

Various oils were tried, including pine, pine tar, stove, acid sludge, pyroligneous-acid residue from Douglas fir distillation, gashouse creosote, wood creosote, and coal-tar creosote used for wood preservation. Wood and coal-tar creosotes were each found to give most satisfactory results. No special study of the character of the various froths was made, but the Canadian and the Japanese creosotes, either alone or mixed, gave firm froths and the best selection of sulphides. The amount of creosote oil for average tests was 0.60% of the weight of the ore.

The antimony content of the flotation concentrates was raised in all of the tests on the original ore. The lowest percentage of antimony was 39.6 (experiment No. 41), and the highest was 66.7 (experiment No. 1). Using creosote oils, the variation in content was from 50 to 65%. The percentage recovered for all tests varied from 54 to 92, but the average of the tests using creosote oils was from 60 to 90%. The corresponding tailings carried 8 to 20% antimony. Some tests in which the creosote oils were used with other oils showed a high recovery; this was due entirely to the creosote oil.

In order to determine whether re-treatment of the tailings would increase the recovery, experiments Nos. 31, 32 and 34 were made on combination samples of tailings from earlier tests. These tests showed that 70% or more of the antimony could be recovered by the use of a secondary machine or by further treatment in the same machine.

A tabulation of the experimental work is given in Table 1.

The conclusions to be drawn from the work are as follows:

TABLE I. FLOTATION TESTS ON STIBNITE ORE FROM THE FAIRBANKS DISTRICT, ALASKA

Original Ore: Sb, 35.0%; Insol., 41.4%. Case Machine Used.

Exp. No.	Ore in Grams	Mesh	Water, C.C.	Oil C.C.	Oil %	Type of Oil Used	Sulphuric Acid, C.C.	Sulphuric Acid, %	Temp. Deg. C.	Time Min.	Speed, R.P.M.	Concentrates Wt.	Concentrates % Insol.	Concentrates % Sb	Tailings Wt.	Tailings % Insol.	Tailings % Sb	Recovery, % Sb	Ratio Conc.	Remarks
1	300	—65	1,200	1.2	0.41	Wood creosote	0.70	0.43	10	10	1,600	97	10.0	66.7	193	60.0	16.6	67.2	3.10	Specific gravity
2	300	—65	1,200	1.2	0.41	Wood creosote	1.05	0.65	10	10	1,600	86	9.2	57.5	174	58.8	17.2	67.0	3.50	wood creosote is
3	300	—65	1,200	1.8	0.62	Wood creosote	0.00	0.00	10	10	1,600	133	17.8	55.1	159	60.5	17.6	72.2	2.25	1.024
4	300	—65	1,200	1.8	0.62	Wood creosote	0.35	0.21	10	10	1,600	112	10.0	64.8	168	65.2	15.0	72.8	2.68	
5	300	—65	1,200	1.2	0.41	Wood creosote	1.40	0.86	10	10	1,600	96	7.8	65.3	183	60.7	16.4	70.8	3.10	
6	300	—65	1,200	1.2	0.41	Wood creosote	1.48	0.91	13	15	1,800	93	9.6	61.3	134	62.8	16.2	71.7	3.20	
7	300	—65	1,200	1.2	0.41	Wood creosote	0.35	0.21	10	15	1,600	135	10.2	58.4	146	65.8	12.7	80.2	2.22	
8	300	—65	1,200	1.8	0.62	Wood creosote	0.35	0.21	11	15	1,600	122	12.0	60.2	158	65.0	14.9	75.1	2.46	
9	300	—65	1,200	2.4	0.82	Wood creosote	0.35	0.21	12	15	1,600	122	12.0	65.0	187	62.4	14.9	73.6	2.46	
10	300	—65	1,200	3.0	1.03	Wood creosote	0.35	0.21	12	15	1,600	135	13.5	56.3	161	65.2	13.8	73.9	2.22	
11	300	—65	1,500	1.8 1.8	1.23	Wood creosote	0.70 0.70	0.86	23	30	1,440	112	11.6	65.0	142	60.0	11.9	82.0	2.68	
12	300	—65	1,800	1.8	1.03	Wood creosote	0.70	0.43	28	15	1,700	101	9.0	67.5	177	59.0	16.4	70.1	2.97	
13	300	—65	2,200	1.8	1.03	Wood creosote	0.70	0.43	28	25	1,700	94	9.7	65.7	161	56.8	17.2	69.2	3.20	
14	300	—65	1,800	1.8	1.03	Wood creosote	0.70	0.43	12	15	1,700	114	11.2	64.5	194	59.8	17.4	68.7	2.14	
15	300	—80	1,800	1.8	1.03	Wood creosote	1.20 0.50	1.04	20	18	2,000	128	16.0	53.1	158	59.4	20.2	68.0	2.36	
16	300	—80	1,900	1.8	1.03	Wood creosote	1.20	0.74	23	15	2,000	144	11.6	51.5	137	64.4	17.7	75.6	2.08	
17	300	—80	1,800	1.8	1.03	Wood creosote	1.20	0.74	23	15	1,900	131	11.5	51.3	148	59.6	20.6	69.0	2.29	
18	300	—80	1,800	1.8	1.03	Wood creosote	0.70	0.43	24	15	1,600	114	9.8	55.3	183	57.8	22.6	60.8	2.14	
19	300	—80	1,800	1.8	1.03	Wood creosote	2.00	1.23	22	15	1,600	118	10.4	54.5	158	58.0	20.4	66.7	2.54	
20	300	—80	1,800	0.2	0.10	Acid sludge	....	....	21	10	1,575	15	....	....	297	....	....	....	....	Specifix gravity
21	300	—80	1,800	0.6	0.30	Acid sludge	....	....	22	15	1,575	98	....	59.8	190	55.0	22.2	54.3	3.06	acid sludge
22	300	—80	1,800	0.8	0.40	Acid sludge	....	....	25	15	1,500	138	....	50.2	147	62.5	20.7	69.5	2.17	1.486; acid con-
23	300	—80	1,800	1.0	0.50	Acid sludge	....	....	27	15	1,570	113	....	54.0	173	56.2	23.1	61.1	2.65	tent, 48.0%
24	300	—80	1,800	1.2	0.60	Acid sludge	....	....	24	15	1,500	96	....	53.0	174	52.5	25.1	53.8	3.10	
25	300	—80	1,800	1.4 0.4	0.90	Acid sludge	10 drops	....	26	17	1,500	98	....	56.7	195	52.3	24.0	54.1	3.06	
26	300	—80	1,800	1.6	0.80	Acid sludge	....	....	22	15	1,550	113	....	54.0	170	54.8	22.3	61.7	2.65	
27	300	—80	1,800	3.0	1.50	Acid sludge	....	....	23	15	1,550	132	....	48.7	151	55.2	23.2	64.6	2.27	
28	226	+100	1,130	1.2	0.50	Wood creosote	0.50	0.40	28	15	1,550	34	10.0	....	183	41.0	24.2	....	....	80-mesh material retained on 100
29	354	+150	1,770	1.8	0.50	Wood creosote	0.75	0.40	25	16	1,550	166	10.2	60.3	172	66.4	18.7	75.5	2.13	80-mesh material retained on 150
30	370	+200	1,850	2.2	0.60	Wood creosote	0.85	0.41	26	20	1,500	222	13.6	59.0	142	78.0	8.2	92.0	1.66	80-mesh material retained on 200
31	522	.....	2,610	3.1	0.60	Wood creosote	1.20	0.40	25	28	1,500	171	19.7	32.5	324	73.2	10.1	62.8	3.08	Tailings from Nos. 1, 2, 3; Sb 16.9%
32	514	.....	2,570	3.1	0.60	Wood creosote	1.20	0.40	26	26	1,500	220	34.4	38.5	287	68.0	11.9	71.8	2.33	Tailings from Nos. 25, 26, 27; Sb 23.2%
33	370	+200	1,850	2.2	0.60	Wood creosote	0.75	0.38	23	23	1,075	221	....	50.0	130	75.8	9.4	90.0	3.80	Pulp from pebble mill
34	287	.....	1,435	1.1	0.40	Wood creosote	0.50	0.32	24	10	1,200	76	....	....	185	73.4	13.9	73.0	2.70	Tailings from No. 32
35	500	—100	2,500	3.0	0.61	Wood creosote	1.17	0.40	28	20	1,300	271	....	55.2	215	75.1	12.1	84.5	2.30	
36	500	—100	2,500	6.0	1.26	Japanese creosote	2.40	0.88	31	30	1,500	...	....	....	...	....	....	....	....	Sp. gr. 1.046
37	500	—100	2,500	6.0	1.26	Canada creosote	2.40	0.88	26	20	1,550	...	....	....	...	....	....	....	....	Sp. gr. 1.050
38	500	—100	2,500	3.5	0.76	Pine tar	1.20	0.44	29	30	1,460	...	....	....	...	....	....	....	....	Sp. gr. 1.090
39	500	—100	2,500	2.7 3.0	1.20	Pyroligneous acid Stove oil	1.20	0.44	35	24	1,400	243	....	53.5	250	75.5	16.8	75.6	2.00	Sp. gr. 1.297 Sp. gr. 0.885
40	500	—100	2,500	4.0 1.5	1.03	Stove oil Japanese creosote	1.20	0.44	28	21	1,500	293	....	52.6	206	77.2	9.8	88.5	2.40	
41	500	—100	2,500	4.0 3.0	1.31	Union Flotation Japanese creosote	1.20	0.44	25	25	1,500	413	....	39.6	74	77.6	8.9	96.2	6.80	Sp. Gr. 0.859
42	500	—100	2,500	2.1 1.2	0.87	Acid sludge Wood creosote	1.20	0.44	25	20	1,500	...	....	....	...	....	....	....	....	
43	500	—100	2,500	1.5 1.5	0.75	Wood creosote Acid sludge	1.20	0.44	26	20	1,500	...	....	....	...	....	....	....	....	
44	500	—100	2,500	4.2	0.79	Gashouse creosote	1.40	0.45	26	20	1,600	184	....	59.3	285	62.8	19.3	66.6	1.40	Sp. Gr. 0.936
45	500	—100	2,500	5.0	0.94	Gashouse creosote	1.20	0.44	27	20	1,600	205	....	55.2	274	68.1	16.4	73.2	1.80	
46	500	—100	2,500	2.5 2.5	0.99	Canada creosote Gashouse creosote	1.20	0.44	27	22	1,400	318	....	45.5	158	73.4	11.8	88.6	3.20	
47	500	—100	2,500	1.0 4.0	0.96	Canada Creosote Gashouse creosote	1.20	0.44	28	20	1,400	279	....	52.6	209	74.3	11.3	86.2	2.40	
48	500	—100	2,500	3.2	0.59	Pine oil	1.20	0.44	28	17	1,550	214	....	57.3	266	70.1	17.1	73.0	1.90	Sp. Gr. 0.930
49	500	—100	2,500	4.1	0.76	Pine oil	1.20	0.44	29	15	1,400	245	....	54.7	237	69.8	14.8	79.4	2.10	
50	500	—100	2,500	1.5 1.7	0.63	Canada creosote Pine oil	1.20	0.44	26	15	1,550	232	....	57.5	254	70.6	15.1	88.0	2.00	
51	500	—100	2,500	1.0 2.6	0.69	Canada creosote Pine oil	1.20	0.44	28	15	1,550	225	....	56.4	240	70.6	15.1	87 9	2.10	
52	500	—100	2,500	2.8	0 57	Wood creosote	1.15	0.43	26	20	1,450	251	....	52.7	213	....	13.1	82.8	2.30	
53	500	—150	2,500	3.0	0.61	Wood creosote	1.15	0.43	28	20	1,500	260	....	59.0	240	....	11.0	85.3	1.90	

The low-grade stibnite ore can be successfully concentrated by flotation methods to yield shipping concentrates.

Fine grinding is necessary for the best recovery and highest grade of concentrate.

The creosote oils, with sulphuric acid, give the highest recoveries at the lowest cost of treatment.

Re-treatment of primary flotation tailings will increase the total recovery.

A summary of the results of the investigation described in the article, "Flotation Tests on an Antimony-Gold Ore," by Earl R. Pilgrim, is of particular interest in connection with the tests described in this article. For purposes of comparison a tabulation is made in Table 2.

Although these tests were made at the same time and were constantly compared and discussed while the work was going on, they were run independently of each other. How far the personal equation entered into the conduct of the experiments is difficult to say, but the results, after the assays and calculations had been made, could not have been influenced by this factor. Were one to draw generalizations, it might be said that Alaska stibnite ores are amenable to successful concentration, using a small amount of sulphuric acid and a varying amount of creosote oil, at temperatures of 15° to 20° C. The ore should be ground extremely fine and the speed of agitation should be 1200 ft. per min. The concentrates will average about 50% antimony, and the recovery will reach 90% as a maximum.

To get further light on the subject of concentration of antimony, analysis was made of the paper by Donald G. Campbell, to which reference has already been made. His tests were made on an antimonial silver ore containing pyrite, stibnite and sulphides and antimonides of silver, totaling about 5 or 6%. The oils used were cylinder and machine mineral oils; sperm, fish and whale oils; commercial cottonseed and rapeseed oils; china-wood oil; resin oil; pine, and pine-tar oils. The final results of the investigation are shown in Table 2.

TABLE II. FLOTATION TESTS ON ANTIMONY ORES

	Nome District	Fairbanks District	Antimonial-Silver
Ratio ore to water	1 to 3	1 to 5	Not given
Mesh	Through 100 on 150 (Tyler Standard)	Through 100 on 150 (Tyler Standard)	—100 (?)
Acid	H_2SO_4 (Sp Gr 1.84) 0.30%	H_2SO_4 (Sp Gr 1.84) 0.44%	H_2SO_4 (Sp Gr 1.84) 0.40%
Oil	Wood creosote 0.20 %	Creosote 1.20%	Pine Tar 0.10%
Temperature	13 deg. C. (55.4 deg. F.)	26 deg. C. (78.8 deg. F.)	18 deg. C. (65 deg. F.) and 65 deg. C. (150 deg. F.)
Time of agitation	15 minutes	15 minutes	2 minutes
Peripheral speed impeller	950–1,320 f.p.m.	1,200 f.p.m.	1,100-1,200 f.p.m.
Per cent. of antimony in concentrates	30-54	50-65	Not given
Per cent. of antimony in tailings	4-14	8-20	Not given
Percentage recovery	40-90	60-90	39-79
Ratio of concentration	3.5 (approximate)	2.0 (approximate)	Not given

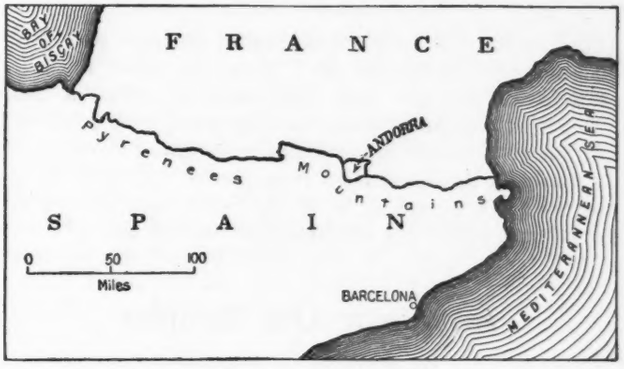
No conclusions can be reached from a study of this investigation, but it seems to indicate that the results from the use of pine-tar oil were not as good as those in which creosote oils were employed. A parallel to this behavior may be found in experiments Nos. 48 and 49, in Table 1, in which pine oil was used on the Alaska ore.

The data available on the subject of the flotation of antimony sulphides are not complete enough to warrant any final decision, but the evidence at hand seems to indicate that stibnite can be successfully concentrated with high recovery by the use of sulphuric acid and creosote oil in any of the mechanical-agitation types of flotation machines.

Mineral Wealth of Andorra

The mineral wealth of the republic of Andorra, according to a recent communication in *Commerce Reports* of the Department of Commerce, is said to be entirely unexploited, although iron, lead and other ores are known to exist there in quantity. The question of mining concessions in the republic is comparatively simple. Under the provisions of a law enacted in 1914 the Council General of Andorra, a body of 24 members, names a representative for exploration and negotiation, who is authorized to transfer the exploitation of the mining interests of the republic to an operating company. It is stated that it is the object of the government of Andorra to facilitate in every way the work of such a company, and that taxes and fees would be reduced to a minimum.

A good municipal road runs through the Balira Valley, connecting Andorra, the capital, with Seo de Urgel, Puigcerda, Lérida, Manresa and surrounding places. When completed, the Trans-Pyrenean R.R. through Ripoll-Puigcerdá-Aix will facilitate communication with Andorra, as



SKETCH MAP, SHOWING THE LOCATION OF ANDORRA

Puigcerdá is 50 mi. from Andorra by the highway. The Balira River, which waters the valley in which the small republic lies, is a tributary of the Segre; the Segre, in turn, flows into the Ebro, forming a water route that could be utilized. Hydro-electric power could be obtained from the tributaries of the Balira.

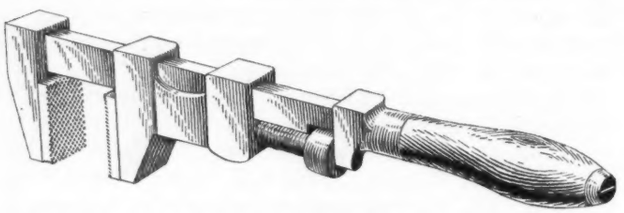
Some specimens of iron ore from Andorra show an analysis between 54 and 79% iron, and veins of hematite, limonite, manganese and lead have been found which, give excellent indications of deposits of commercial value, the exploitation of which should be encouraged.

Andorra is described as follows in "Lippincotts Gazetteer," "A neutral country with the name of a republic, situated on the south side of the Pyrenees, between the French department of Ariège and the Spanish province of Lérida, surrounded by high mountains on which the snow lies for six months in the year. Area, 175 sq.mi. Its climate is cold but healthful; the soil is unproductive in grain, but there are rich iron deposits and valuable forests. Oats and barley are the only crops. The government, a democracy, is vested in a council of 24 members, elected by the whole population. The executive head is a syndic, elected by the council for life. Andorra is nominally subject to the suzerainty of France and of the bishop of Urgel. The inhabitants, mostly shepherds, speak the Catalan language. Population, about 6,000. The independence of this little state is reputed to date from the time of Charlemagne, about 790. The capital is Andorra."

Details of Milling and Smelting

An Emergency Pipe Wrench

A construction gang putting up a small boiler and engine in the country was hampered to some extent be-



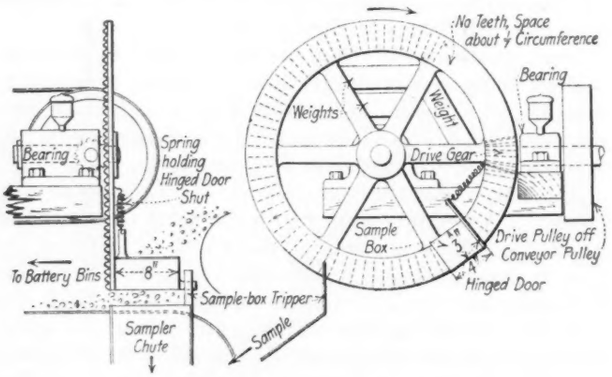
PIECES OF OLD FILE ON MONKEY-WRENCH JAWS

cause part of the tools (including all the pipe wrenches) had not arrived on the job. Since no other wrenches were available, the men proceeded to make a pipe wrench out of an ordinary monkey wrench by soldering two pieces of an old rough file on each jaw of the wrench, as shown in the illustration from *Power*. They used this for two days, according to M. A. Saller, and did a good bit of work before the lost shipment turned up.

Automatic Ore Sampler

By Arthur C. Daman*

The ore sampler shown in the accompanying drawing is probably one of the simplest and most practical in use today. It is used at the Belmont mill, Millers, Nev. The sample box is fastened on a 3-ft. geared wheel which has part of its teeth removed. When the no-teeth area, which



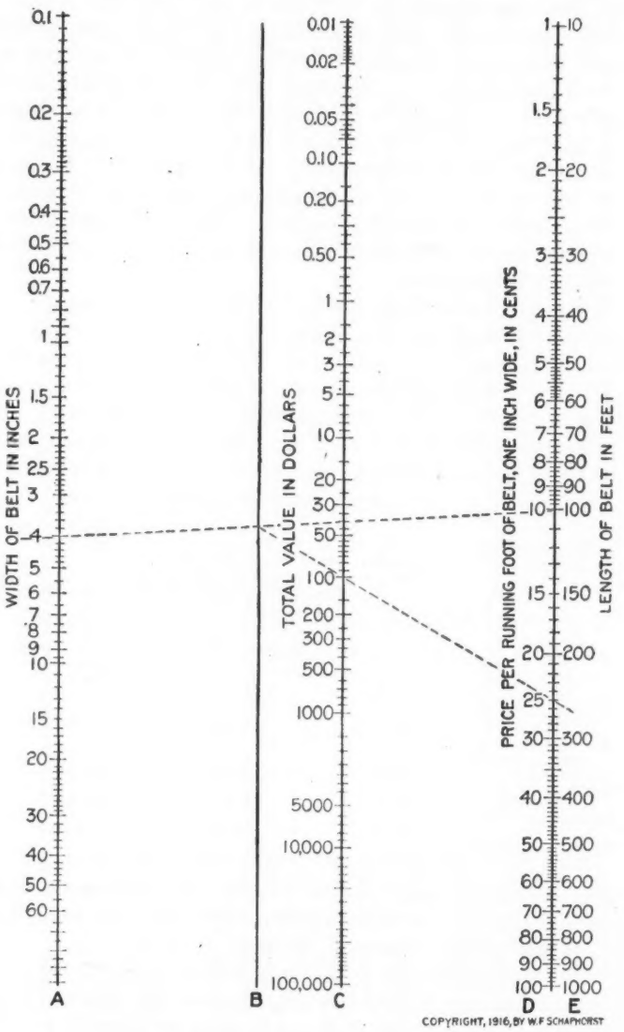
AN AUTOMATIC ORE SAMPLER

comprises about one-seventh of the total circumference, reaches the drive gear, the weights cause the sample box to rapidly cross the stream of ore. On spanning the stream, the gears again mesh and the automatic tripper empties the sample into the sample chute. The speed of the sampler can be adjusted by different size pulleys connected to the conveyor belt.

*Mining engineer, 2678 Fudora St., Denver, Colo.

Belt-Cost Estimating Chart*

On account of the fluctuating cost of belting it is difficult to keep a price list up to date, and by reason of the fact that belt widths vary so widely and lengths are seldom the same, a different calculation is necessary for almost every drive and at least for every item. To assist the belt user, the belt buyer and the belt salesman, I have



A CHART TO FIND THE COST OF BELTING

therefore developed this chart, for when using it the only price the buyer or salesman has to bear in mind is the price per running foot of belt 1 in. wide (see column D), which I call the *unit price*.

For example: What is the total value of a belt 4-in. wide and 100 ft. long, the unit price being 25c.?

*Copyright, 1916, by W. F. Schaphorst, Woolworth Building, New York.

Connect the 4 (column A) and the 100 (column E) and find the intersection with column B. From the point of intersection run over to the 25c. (column D), and the answer or *total value* ($100) is found in column C. Thus, all one needs to do is to lay a straightedge across the chart twice and the problem is solved.

This chart is based upon the fact that the price of belts generally varies directly with the width and directly with the length. It is not absolutely accurate, of course, because it does not give fractional dollars or cents, but for the estimator it does the work accurately enough and will be found handy for checking pencil figures and "long-hand" methods. A trial and everyday usage will convince the user that it is "pretty close." The range of the chart, it will be observed, is very wide—wide enough for nearly every problem that ever confronts the buyer or seller.

Hints for Operators of Small Mills

In the report of the Rhodesia Munitions and Resources Committee for the first half of 1916 are found several useful hints to operators of small mills.

It is essential in a stamp battery that guides be kept well fitted to the stems. A large amount of play results in broken stems and other parts, cracked mortar boxes and uneven wear of dies, necessitating a large amount of metal being discarded.

Amalgamating plates should be regularly dressed to keep the surface in a good condition for catching gold. Great care should, however, be exercised to make sure that too much mercury is not used. The tendency in many cases is to have the plates too wet, which results in a loss of both mercury and gold.

Packings, either steam or water, should be stored where dust or grit cannot get at them and in a cool damp place, as dirty packing will cause scoring of rods, making it impossible for the glands to be kept tight. When taking packing underground to pumps, it is advisable to have it cut to the correct lengths on the surface and carried underground in a closed canvas bag. In steam sinking pumps a cup lubricator is generally put on top of the cylinder, and the pump boy as a rule fills the lubricator from a bottle at such intervals as he considers necessary. In the large majority of cases the lubricator valve is then opened full and all the oil in the lubricator is blown through the exhaust pipe almost at once. This method is not only very wasteful in oil, but also prevents the cylinder and valve from getting the regular lubrication that is necessary, and consequently the life of the pump is shortened. A better method is to fix a sight-feed lubricator on the steam pipe either at the top of the shaft or at the nearest station above the pump, and regulate the oil feed from there. At such places the lubricator is easy of access and is not liable to break as if fixed on the pump. Surplus oil should, wherever possible, be caught up and filtered for re-use.

In many cases too much cyanide is used in cyanide plants, the solution being regularly over-strength. As the test for strength is so simple, there should be no excuse for this. The same is true of lime, which is frequently dumped into a plant casually instead of being regularly fed in correct quantities. Excess lime, particularly lime containing magnesia, may cause extra expenditure in connection with extraction and clean-up.

Slags, old crucibles and other valuable byproducts should not be put through the battery, but should be accumulated and sent to a works where they can be profitably treated. When put through a battery, in many cases little if any recovery of the gold contents is made. The quantity treated at a time is generally small, and because no gold is noticed in the tailing of the mill it is often thought that it is being recovered. It should be remembered, however, that with a small quantity going through, the chances are much against a tailing sample being taken at the time when the tailing from the by-product being treated reaches the discharge outlet of plant.

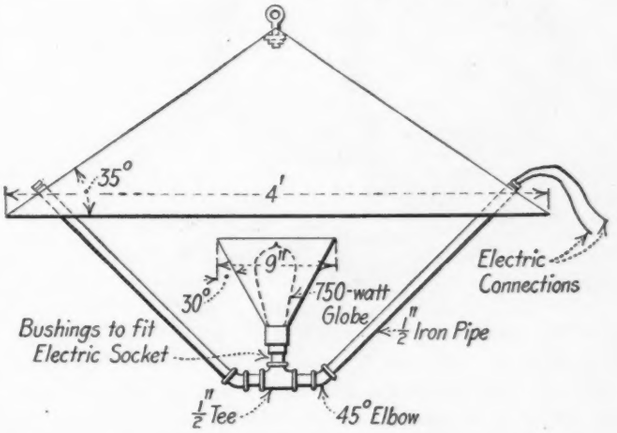
In a large number of cases no regular samples are taken for fire assay, reliance being placed on panning. This answers very well in some cases, but not in all. When there is any doubt as to the percentage of recovery and assay value of heads and tail, samples should be taken for fire assay. If it is desired to avoid the expenditure for daily fire assays, samples can be taken, spread over, say, weekly periods.

When retorting amalgam, particular care should be taken that there is no loss of mercury. In many instances the cover of the retort is not luted tight, while in others the pipe in the cover of the retort allows leakage of mercury vapor along the thread. If in all cases the amalgam is weighed before retorting and the sponge gold and condensed mercury weighed afterward, any loss can at once be detected.

When there is the slighest doubt as to efficiency in methods of working, a little money expended in getting competent mining, metallurgical or mechanical advice is thoroughly justified and will in most cases result in considerable financial gain to the operators.

Mill Lighting Fixture

The homemade indirect-lighting fixture shown in the accompanying sketch is now being used to replace the Cooper-Hewitt lamps in the Tonopah-Belmont mills. The reflectors are made of light galvanized iron, and the remaining parts are of pipe fittings. The lamps were constructed by the electrician and have made a great improvement in the lighting of the mill. For illumination, 750-watt tungsten lamps are used. Illumination of this sort provides a diffused light that is very satisfactory and aids in producing good mill results.



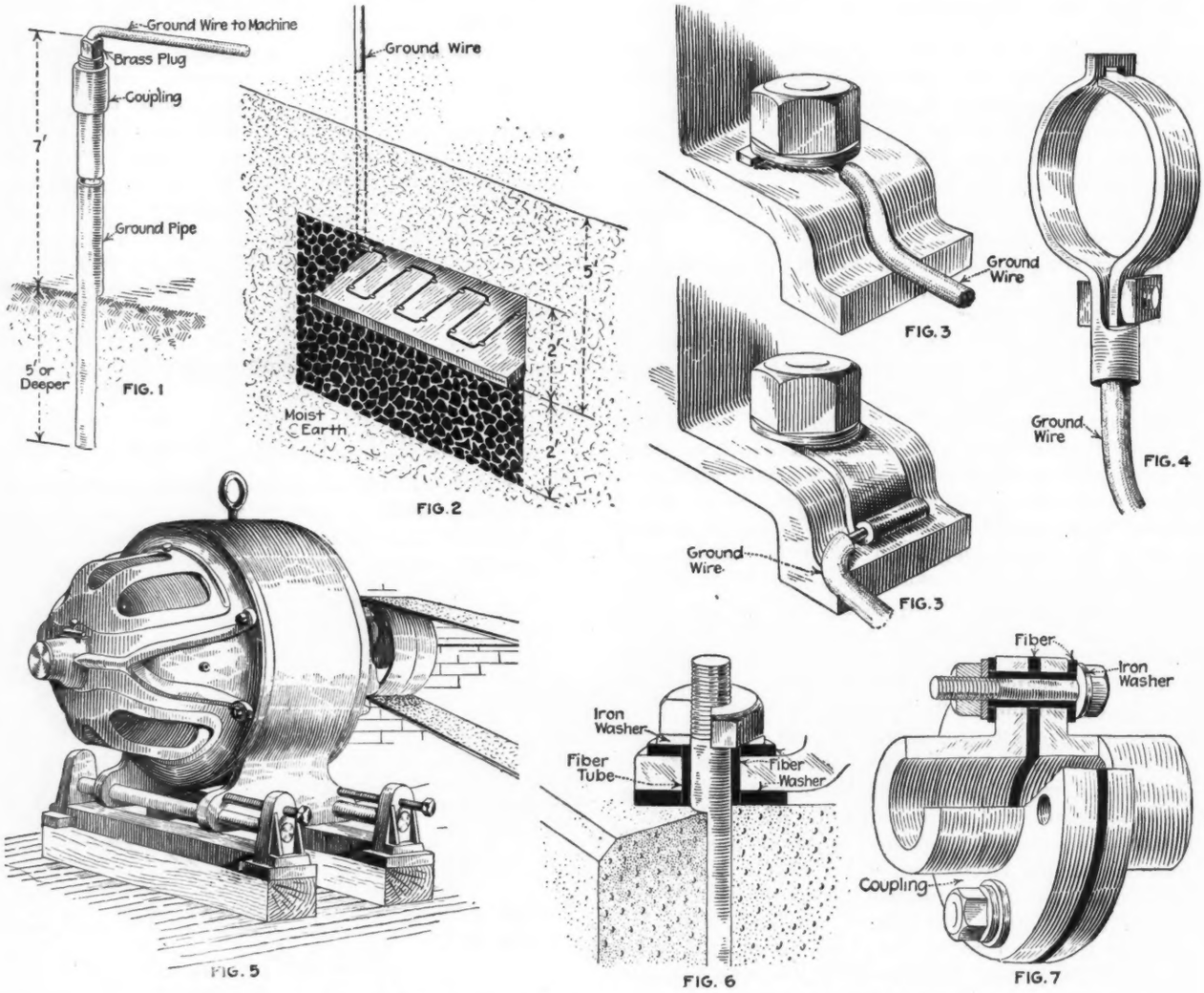
A MILL-LIGHTING FIXTURE

Details of Practical Mining

Electric Motor Grounding and Insulation

The necessity for the proper insulation of electrical apparatus is everywhere recognized. Electrical apparatus of all kinds, machines, conductors, etc., however well-insulated, should be considered as being alive and treated in such a way that under no conditions can a short-circuit or ground occur, and so insulated that leakage between conductors and between conductors and the ground will be reduced to a minimum. The mechanical construction of the work should receive particular attention, especially the careful and neat running of wires, the making and soldering of connections and the securing and attaching of the wires from the terminal to the setting. All these things are necessary for the safeguarding of life and property.

The National Board of Fire Underwriters' Code specifies that all motors operating on circuits of 550 volts or over must have their base-frames positively grounded; a ground is understood to be a permanent electrical connection to the earth, which is made in a number of different ways. Water pipe and gas pipe are considered to be properly connected to the earth, and ground wires can be attached to them. A length of galvanized pipe may be driven into the ground until it is in contact with permanent damp earth, extending at least 7 ft. above the surface of the ground, and 5 ft. below it if moist earth can be reached at that depth. If there is any difficulty about making good contact between the pipe and the earth, owing to lack of moisture, dig a pocket around the pipe to a depth of 4 or 5 ft., pack pea-size pulp or charcoal tightly around it. The

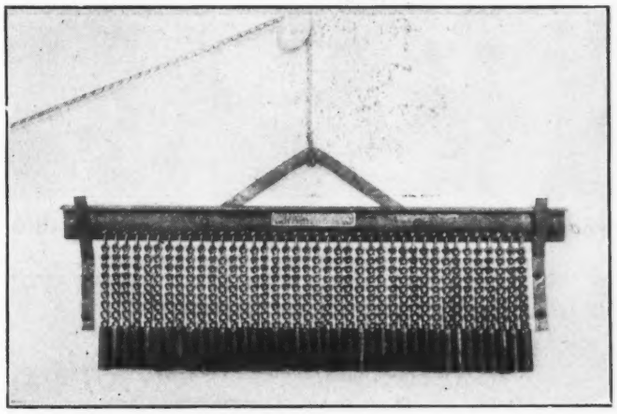


DIFFERENT METHODS OF GROUNDING AND INSULATING MOTORS AND ELECTRICAL MACHINES

grounding wire is fastened to the pipe by soldering it to a brass plug screwed into a coupling that is placed on the end of a pipe after it has been driven into the earth. This is the most common method of forming a ground where no other means is available and is shown in Fig. 1, from *Power* of Jan. 2, 1917. Where several devices close together are to be grounded, the type of ground shown in Fig. 2 is to be recommended. This is composed of a copper plate to which is soldered the ground wire of copper. Ground connections may be made by means of the foundation bolts, as shown in Fig. 3. If this type of ground is used, it must be soldered firmly to the base. Fig. 4 shows a clamp for grounding through a pipe. If for any reason it is desirable to insulate the motor from the ground rather than to ground it, the base shown in Fig. 5 is recommended. This is made up of two wooden blocks and also provides a convenient means of belt tightening. If the machine is of a larger type and is mounted on a concrete or stone foundation, insulation is accomplished as shown in Fig. 6, by means of fiber washers on the foundation bolts. If the machine is direct-connected to the load and insulation is required, the shaft insulator shown in Fig. 7 is recommended.

Chain Screen Door

The accompanying illustration from the *American Machinist* of Dec. 14, 1916, shows an improved form of chain screen door for oven and furnace openings. This door was designed to eliminate the discomfort of the heat and gases coming out through the uncovered opening, when the doors are thrown open, and the loss of efficiency through the chilling effect of the inrushing cold air. At the same time the form of chain door shown permits an



CHAIN SCREEN DOOR FOR BOILER AND SMELTING FURNACES

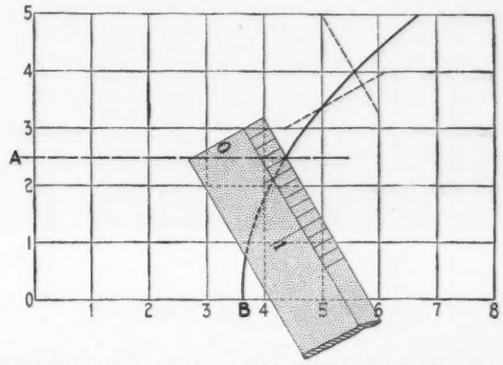
unhampered view of the interior, as the glare is toned down. The doors are made automatic and nonautomatic.

The automatic is employed mostly in boiler furnaces where the opening of the ordinary fire-door causes the screen to unroll from a cylinder hung above the furnace opening. The nonautomatic, which is much used on ovens and other furnaces, is much simpler in construction. The chains forming the screen are suspended from a bar and may be raised out of the way by a hand chain running through a pulley overhead. When needed, the screen is lowered into supporting brackets.

In some plants the chain screens are attached directly to the bottom of the ordinary furnace door. When the door is raised, the opening is covered by the screen. When the door is lowered, the chain screen drops down below the hearth. This form is used where the hearth does not extend beyond the bottom of the vertically sliding door. This screen is made by the E. J. Codd Co., Baltimore, Md.

Reading Copied Charts

When it is found necessary to read coördinate values from curves that have been reduced for printing, it is often difficult to measure these directly with a scale, because the curves are ordinarily not reduced to any particular scale for this purpose. When it is necessary to determine these intermediate values closer than can be done by estimating, the following method will give ac-



METHOD OF READING ACCURATELY CAPIED CHARTS

curate readings, using any scale: As shown in the illustration, place an ordinary graduated scale with one graduation on one ordinate line and another graduation on the ordinate line below it, and then slide the ruler along until the edge intersects the curve at the point to be read. If the scale used is divided in tenths, the reading is a direct decimal and if not divided in tenths the reading is a fraction, which is easily handled. This is based on the theorem of proportional triangles.

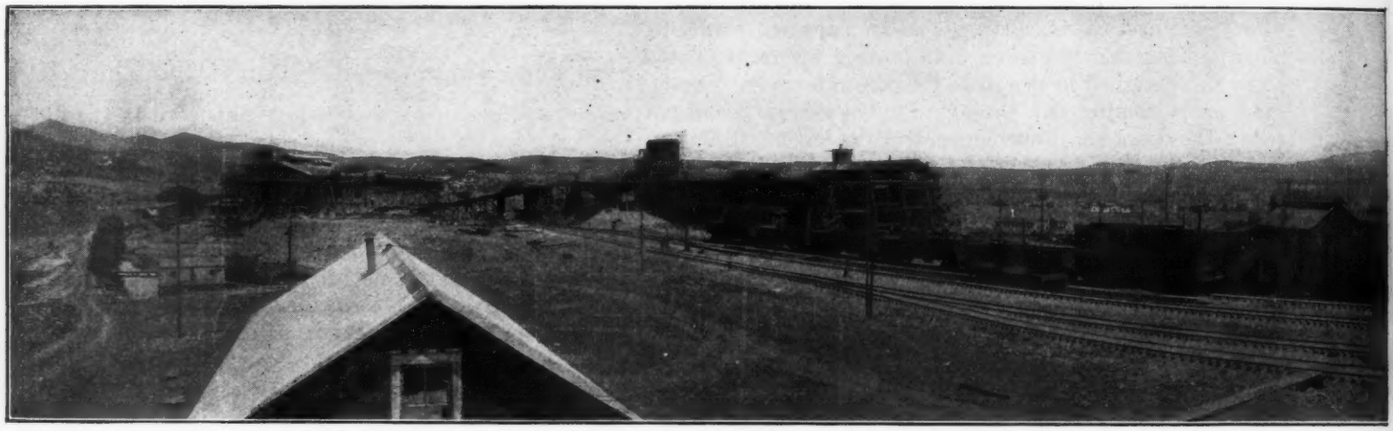
Fire Protection in Shafts

The importance of adequate fire protection facilities is shown by the following occurrence during an unwatering project on the Comstock Lode, Nevada. A fire broke out at the 1500-level station in the pumping incline, and although there were two 12-in. water mains connected each to a 200-h.p. pump and passing directly through the zone of fire, there was no way of getting water on the fire as no connections had been put in for such purposes and it was impossible to install such in the gas and smoke so the blaze could not be readily extinguished.

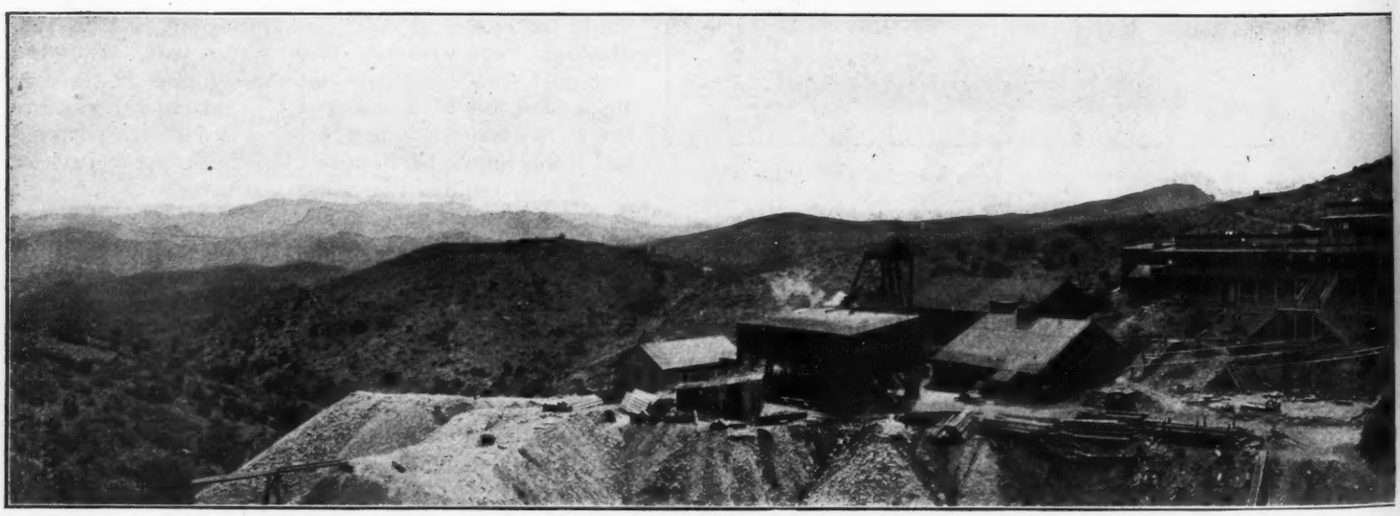
There were at hand a number of chemical fire extinguishers which were used. When they were turned upon the fire in the necessarily poor ventilation underground, the resulting carbon dioxide promptly drove the men using them away from the fire and did not seem to reduce the blaze materially. In the installation of any mine pumping plant, there should be included at every station or convenient location in the pump column, valves for the outlet of water in case of fire and the pumpmen should have orders that if they have to leave the pump on account of fire to leave it running so that there will be right at hand, a most effective defence in case of fire.

Consolidated Arizona Smelting Co.'s

TOWN OF HUMBOLDT AND THE CONSOLIDATED ARIZONA SMELTING CO.'S

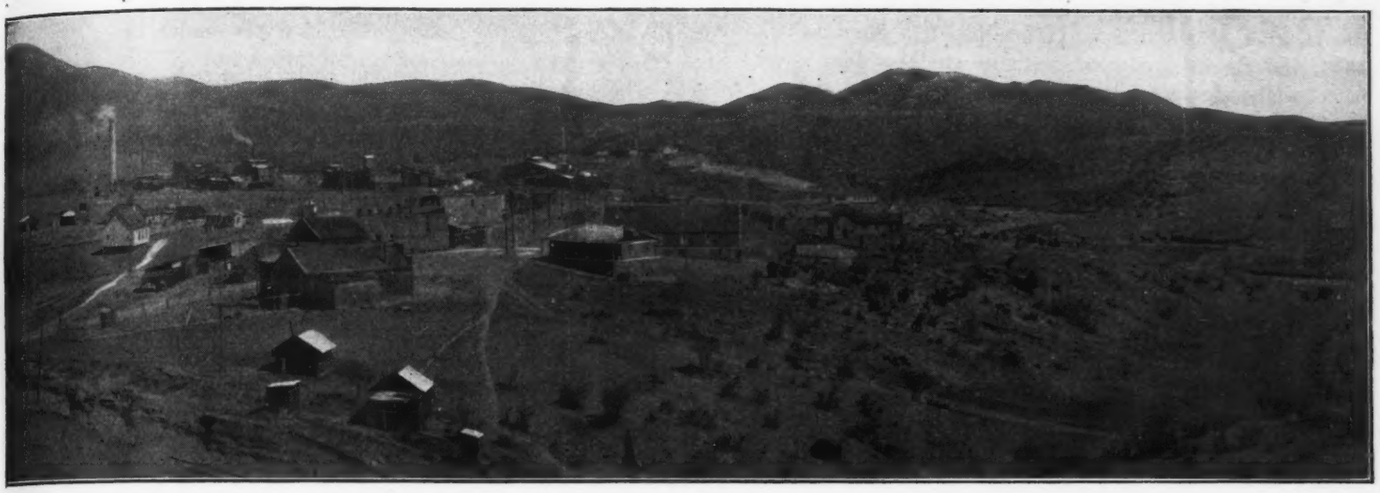


CLOSER VIEW OF REDUCTION WORKS—AT EXTREME LEFT, THE CONCENTRATOR; THEN ORE BINS

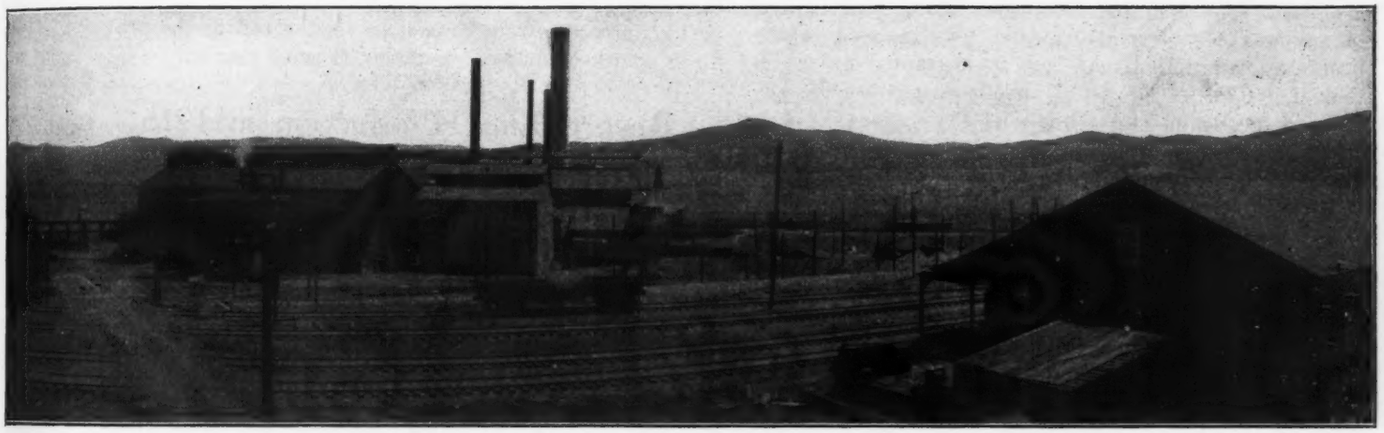


BLUE BELL MINE AND 4-MI. TRAMWAY—THIS MINE HAS 1000-FT. SHAFT AND PRODUCES 250 TONS DAILY.

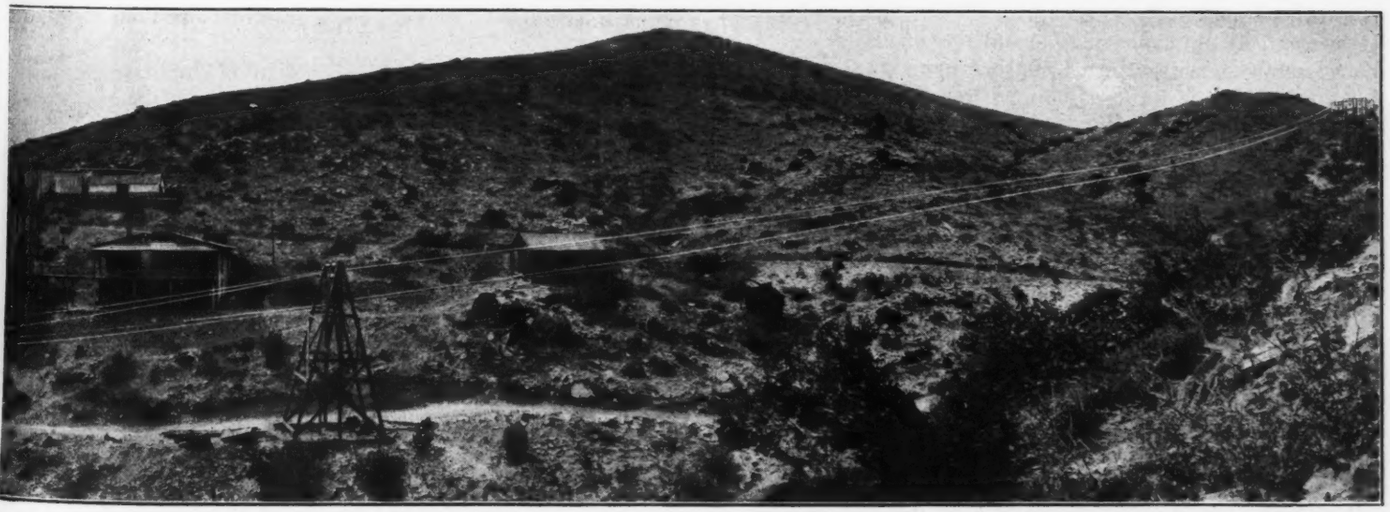
Operations near Humboldt, Arizona



REDUCTION WORKS; BRADSHAW MOUNTAINS IN BACKGROUND



AND SAMPLING MILL; ABOVE, THE SMELTING PLANT; AT EXTREME RIGHT, THE MECHANICAL SHOPS



MAINLY CONCENTRATING ORE; COMPANY'S DE SOTO MINE, 8 MI. DISTANT, SUPPLIES 100 TONS DAILY

British Copper Regulations

The following notice (Serial C, 3178) published in *Mining Journal*, London, Jan. 6, 1917, was issued by the Press Bureau on Jan. 2, 1917; the Minister of Munitions, in exercise of the powers conferred upon him by the Defence of the Realm (Consolidation) Act, 1914, the Defence of the Realm (Amendment) No. 2 Act, 1915, the Defence of the Realm (Consolidation) Regulations, 1914, and all other powers thereunto enabling him, gives notice and orders as follows:

(1) He thereby takes possession as from the date hereof until further notice, upon the terms specified in the schedule hereto, of all unwrought copper, including copper scrap and swarf, in any form whatsoever, subject to the following exceptions: (a) Rough copper, copper ore and copper scrap and swarf in the possession of, or due under an existing contract in writing for future delivery to, a smelter or refiner for the purpose of conversion into refined metal. (b) All copper, including copper scrap and swarf, in the possession of or due under an existing contract in writing for future delivery to a manufacturer for use in such manufacturer's own works. (c) Copper scrap and swarf specially excepted under the written authority of the Minister of Munitions.

(2) If any person having control of any metal to which the notice applies, without the consent of the Minister of Munitions sells, removes, or secretes it, or deals with it in any way contrary to any conditions imposed in any license or permit that may have been granted in respect thereof, he will be guilty of an offence against the Defence of the Realm (Consolidation) Regulations, 1914.

(3) All existing licenses issued by or on behalf of the Minister of Munitions for dealing in any scrap or swarf to which this notice applies are hereby cancelled.

(4) The Minister of Munitions hereby requires every smelter or refiner to make a return to the Director of Materials at the end of each calendar month, including the month of December, 1916, of the total quantities of refined copper of each description in stock, distinguishing between (1) that sold for use on Class "A" or Class "B" work; (2) that allocated for such use in his own works; and (3) the residue not so sold or allocated; and he further requires every maker and holder of copper scrap or swarf to make a return to the Director of Materials at the end of each calendar month, including the month of December, 1916, of the total quantities of each class of such scrap or swarf in stock, distinguishing between (1) that sold for use on Class "A" or Class "B" work, (2) that allocated for such use in his own works, and (3) the residue not so sold or allocated.

(5) All applications with regard to this Order should be addressed to the Director of Materials, A.M. 2 B., Armament Buildings, Whitehall Place, London, S.W., and marked "Copper Permit."

Schedule—(a) Copper included in the returns made in accordance with Clause (2), Sections (a), (b), and (c) of the Order made on Dec. 8, 1916, and taken over under the above Order (except copper due for future delivery on sliding scale terms), will be paid for on delivery by the Minister of Munitions on the basis of the value as indicated by the average of the official quotations of the London Metal Exchange for the last fifteen days of December, 1916. Copper due for future delivery on sliding scale terms will be paid for at not more than 10s. per ton of metal over the original full contract terms, including all discounts, commissions, or rebates of any sort. Special circumstances in connection with any copper taken over may be taken into consideration by the Minister.

(b) A price schedule for copper scrap and swarf, based downward on the quotation for electrolytic copper as a standard, will be drawn up by the Director of Materials for the purpose of the taking over of stocks under the above Order and as a basis for future transactions.

(c) The quantities of refined copper specified in the returns of smelters or refiners under Clause (4) of the above Order, and not sold or allocated as therein mentioned, will be paid for on delivery by the Minister at the average of the relative official quotations of the London Metal Exchange for the month in question.

(d) The scrap and swarf specified in the returns by makers and holders under Clause (4) of the above Order, and not sold or allocated as therein mentioned, will be paid for on delivery as may be directed by the Minister on the basis of the average of the quotations for electrolytic copper for the month in question, subject to any adjustments for quality that may be necessary.

(e) In all cases where two prices are quoted for the same description of copper by the London Metal Exchange, the price paid by the Minister, if based thereon, will be the mean of the two prices, and all prices paid by the Minister will be net per ton delivered c.i.f. U.K. port if imported from abroad, or free on rail at the producer's works if made in England, or equal thereto.

Record Lime Production in 1916

Lime production and sales in the United States during 1916 gained 15% over those of 1915, according to the estimate made by G. F. Loughlin, of the United States Geological Survey. The estimated market production was 4,150,000 short tons, compared with 3,622,000 short tons produced in 1915. This was the first year in which the output exceeded 4,000,000 tons.

The estimated production in short tons of the leading states was as follows: Pennsylvania, 1,037,000; Ohio, 529,000; Virginia, 350,000; West Virginia, 310,000; Wisconsin, 259,000; Missouri, 204,000; Maryland, 168,000; Maine, 152,455; Massachusetts, 139,000; New York, 124,000; Indiana, 120,000; Tennessee, 120,000. Sales of byproduct lime totaled 710,000 tons, a gain of more than 13%.

In the New England States production of lime increased 5%. In the Southern States south of the Potomac and Ohio and east of the Mississippi, production increased 22%. In the West Central States the increase was 27%. In the Southwestern States the greatest proportional gain of any section was made—30%. Pacific Coast States gained only 3%, and in the Rocky Mountain States, although smeltery demands increased, the total production decreased 8%.

Production was handicapped by shortage of labor, even at increased wages, and shortage of both fuel and cars.

British Prohibition on Gold and Silver Articles—All articles manufactured solely or partly of gold or silver and all jewelry containing gold, silver, or platinum prohibited importation United Kingdom, according to "Commerce Reports," of the Department of Commerce, Washington, D. C. Jewelry manufactured solely of base metals admitted as formerly. This is in the nature of an interpretation of the proclamation prohibiting the importation of jewelry, etc.

A New Method of Zinc Precipitation

By H. R. Conklin*

With the object of eliminating the necessity of using zinc in the form of dust or shavings for the precipitation of gold and silver from cyanide solutions, a new method of precipitation has been devised and a machine invented for its practical application. The apparatus can be used for precipitating other metals from their solutions also, particularly for precipitating copper with iron.

The aim of the invention is twofold—first, to apply the zinc precipitant in its cheapest form, and second, to obtain a precipitate free from impurities, especially from zinc.

The basic idea is to pass the pregnant solution over and through a quantity of small balls of zinc, with other small pieces of zinc, the flow of the solution and the rolling action of the pieces of zinc combining to remove the precipitate from the zinc, the separation of the precipitate from the barren solution taking place after leaving the machine.

The experimental machine first constructed had a spiral rib inside a pipe of 12-in. diameter, inclined at 30° and acting on the principle of an Archimedean screw,

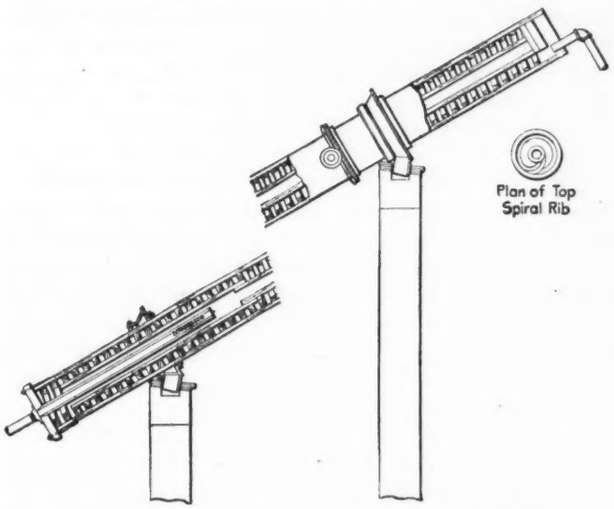


FIG. 1. SECTIONAL VIEW OF THE CONKLIN PRECIPITATOR

so that as the entire pipe slowly revolved, the zinc balls rolled around on the spiral rib and advanced toward the upper end of the main pipe. The lower end of the main tube, as shown in Fig. 1, had the spiral rib high enough to touch an inner tube which had a closed top, so that the lower part of the main tube had a spiral channel between the main and inner tubes, defined by the spiral rib. The spiral rib at the top of the main tube, as shown in Fig. 1, was so shaped that it delivered the zinc balls, as they moved along the upper end of the spiral rib, into a small central pipe, down which they ran to the bottom of the machine, where they again started rolling up the spiral rib toward the top. The zinc balls were removed from the solution by the spiral rib just before they were delivered into the small central pipe, and no solution flowed down this central pipe.

The main part of the tube, above the inner tube, called the head of the machine, was kept fairly well filled with zinc balls and pieces of zinc of other shapes, only the balls rolling up the spiral rib and making the circuit of travel, while other-shaped pieces or very small balls, which accumulated as chemical action took place, remained in the head, where the action of precipitation was most intense and where they were finally completely consumed. The slow rolling of the main tube gave sufficient agitation to the zinc and solution to provide contact of all the solution with zinc and precipitated the gold and silver. This rolling also loosened whatever particles of precipitate adhered to the zinc, so that all the precipitate was carried along with the solution as it left the machine, and the surface of the zinc was kept clean and chemically active.

Pregnant solution entered the machine at the top, flowed down through the slowly turning zinc, followed the spiral path around the inner tube, and left the machine through an outlet pipe so designed as to prevent any zinc from being carried out with the solution, which carried the precipitate with it. The continuous movement of zinc balls against the flow of the solution assured the contact of all the solution with zinc during its entire passage through the machine, and the accumulation of all irregular and small pieces of zinc in the head of the machine prevented any zinc leaving the machine with the precipitate.

Galvanic Action Prevents Silver Precipitation

In experimental and testing work the first machine was made of iron and did not precipitate a silver cyanide solution. After much investigation it was discovered that when zinc is in contact with iron in silver cyanide solution, some galvanic action takes place which prevents the precipitation of the silver, although some iron cyanides are precipitated. This discovery explained a situation that had once arisen when attempting to precipitate with zinc shavings in iron boxes. It explains also why poor or no precipitation took place when passing solution through tube mills containing zinc. Probably zinc dust, when mixed with solution, is slightly affected by contact with the iron of pump and pipes, but so little of the dust is in actual electrical contact with the iron that the effect is inappreciable.

This discovery sent the iron machine to the scrap heap and led to the construction of a wooden one, with which proper precipitation took place. The first wooden machine was constructed entirely of wood, a 12-in. wooden-stave pipe having wooden spiral ribs, wooden pipe down the center, wooden inner tube and discharge pipe, as shown in Fig. 1. The wear on the wooden surfaces caused by the rolling zinc balls, although two months' test operation did not seriously impair the machine, was sufficient to shorten its life unduly. Machines will now be made with cast-zinc linings for the main wooden tube, the linings carrying the spiral ribs on their inner surfaces. This increases the area of zinc surface in contact with solution, and any wear or dissolving action on this lining simply aids precipitation.

The experimental work was carried on at a point where changes were very hard to make. For this reason, the zinc balls, although too large to provide sufficient zinc surface, could not be changed, and the insufficient zinc surface in the machine prevented a complete precipitation, although, after adjustment and some experience in operation, an assay of tail solution showed Au 0.006 and

*Mining and electrical engineer, Joplin, Mo.

Ag 0.28 oz. per ton, compared with a pregnant solution entering the head of the machine assaying Au 0.046, Ag 2.30 oz. per ton.

The separation of the precipitate from the solution was effected by discharging the machine into a steep conical tank, as shown in Fig. 2, the Conklin Directed Thickener being used in the trial operation with satisfactory results, and filtering through bag filters. With this way no pumping was necessary, the pressure at the bottom of the conical tank being sufficient for filtering.

It was found that there was a tendency for the precipitate to redissolve, but by lining the tank with sheet zinc and constructing the inner cones of the Conklin thickener of sheet zinc, discharging all the solution through bag filters attached to the bottom of the tank, this re-solution was prevented. Apparently the presence of zinc in the mixture of barren solution and precipitate is sufficient to prevent re-solution, the sheet zinc in the tank showing no chemical action.

The precipitate consisted of about half each of the usual black precipitate and tiny bright metallic silver

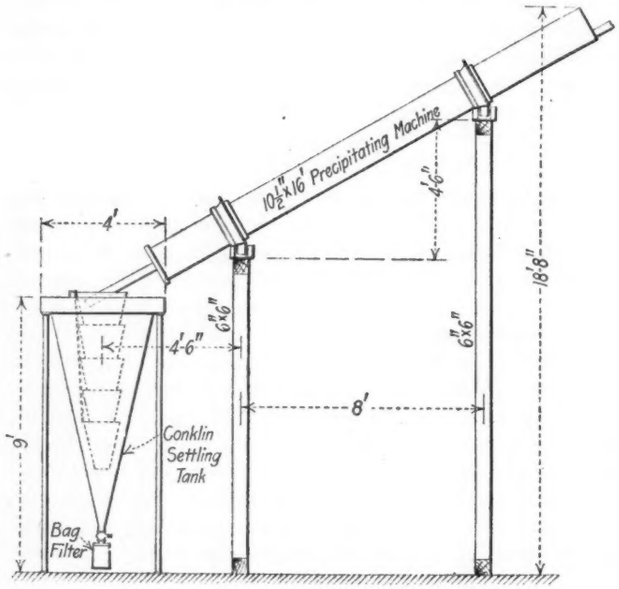


FIG. 2. PRECIPITATING TUBE DISCHARGING INTO CONICAL THICKENER

scales, with but a trace of zinc. The average of six assays of precipitate showed Au 375.06 and Ag 19,322.8 oz. per ton, impurities consisting almost entirely of wood pulp worn off the machine and filtered out with the precipitate.

In the newest machines, the increase of zinc surface, thanks to the cast-zinc lining and to the reduction in size of the zinc balls, should furnish practically complete precipitation.

This method of precipitation has several advantages, among which are the following: No excess of zinc is used, but just sufficient; zinc is used in its cheapest form; clean precipitate is produced, which can be melted with a minimum amount of flux, yielding the highest-grade bullion and saving the cost and loss of acid during the treating and roasting of the precipitate. Since so much attention has been given to testing, and so much care taken to perfect the process, it seems reasonable to consider it practical.

Combinations To Conserve Natural Resources

At a luncheon of the Chamber of Commerce at Pittsburgh, Jan. 2, W. L. Saunders, of the Ingersoll-Rand Co., made an address in favor of legalizing combinations to conserve natural resources, which is of such interest and importance to the mining and metal industries that it is given here in full as follows:

I feel that the invitation which you gave me to come to this luncheon and talk about Referendum No. 17 of the Chamber of Commerce of the United States is a summons to do my duty. It is also a privilege, because if the Committee of the National Chamber is sincerely seeking to carry out its recommendations in this Referendum Report, they should welcome an opportunity to explain and elucidate the subject in this great mining and industrial region of the United States.

The question before you is, Shall legislation be urged before Congress to permit coöperative agreements under Federal supervision in certain primary natural resources, such as timber, the ores and deposits of useful metals and the deposits of minerals which are a source of heat, light and power? The chief reasons why we seek an affirmative answer to this question are, that through coöperation the basic natural resources of the United States will be conserved; that human life, among persons engaged in those industries, will be better cared for, and that the safety, welfare and prosperity of our people now and in future generations will be increased.

Only Primary Natural Resources Considered

Remember that we are dealing in this matter only with primary natural resources and that we propose to permit coöperation only under Government supervision and regulation. What are the primary natural resources? Concretely, they are forests, natural-gas and oil deposits, coal, iron ore and metalliferous ores; but speaking in general terms, these things are the sinews of national security and prosperity in peace and war.

We are an industrial, not an agricultural, nation. It is because we have advanced from the farm to the workshop that we have grown great and rich. Our fathers developed these fields through the cultivation of the soil. Through their labors America sustained human life throughout the world, but nature has provided us with something more than surface fields for cultivation. We have found other resources, and through the development of these resources we have become the largest industrial factor in the world. Just as the farm sustains human life, so does the mine sustain industrial life. Human capacity to produce through manual labor in the field is limited to a little more than human capacity to live. A big agricultural country does not grow rich and powerful. It does not build up large cities, but it goes on through the even tenor of its way in perpetual desuetude. Not so with a country rich in mines and minerals. Look at Pittsburgh, look at Sheffield and Birmingham, and the distinction is apparent.

There are three great industrial nations in the world: The United States, England and Germany. Belgium, before the war, was great in industry, though limited in size. Russia and China are great in territory and in wealth, but they do not figure industrially as the world is measured, either because of lack of development or

through limitations of raw material. The true measure of an industrial nation is its consumption of coal. A nation might produce a large volume of coal and iron ore, but unless it utilizes this production in industry, it does not become great in industry. The United States consumes about 5 tons of coal per capita per annum, England and Germany each consume about 4 tons, while the consumption in France is a little more than 1½ tons and in Russia about ¼ of a ton. We consume about 16 lb. of copper per capita per annum, while in Asia, for instance, this consumption on the entire continent is only a fraction of a pound. Asia is in the position the world was in centuries ago, but even Asia may grow industrially, and if so it will be necessary to draw upon the primary resources of the world and mainly of America.

Let us see what is involved in the consumption of coal, oil and ores through industry.

During the last twenty-five years the population in the United States has increased about 70%, while the products of these important basic industries have been consumed at a rate of increase between 500 and 600%. The entire world one hundred years ago produced only about 3000 tons of copper per annum. The United States alone today produces over 600,000 tons. The world produced one hundred years ago only about 50,000,000 tons of coal per annum. The United States alone now produces over 500,000,000 tons. How long can this last, and what will happen when exhaustion takes place? America is the largest producer in most of these things. We export more than half of our copper. The first result of partial exhaustion will be increased prices. This, of course, will restrain industry. It will also restrain our ability to defend ourselves in war, for everyone knows that the supremacy of a nation in war today depends upon its strength and capacity in oil, coal, iron and metals. Plenty of soldiers and even plenty of money are not sufficient to resist attack. A nation might be rendered powerless against a smaller country through lack of industrial strength through industrial resources. The real reason why an *impasse* apparently now exists in the war in Europe is because in industrial strength the Allies and the Central Powers are about equal.

It may be taken for granted, I think, that everyone would agree that our primary natural resources should be conserved. The only element of doubt in the matter would be as to how to conserve them. There are many ways of doing this, but as in all big movements, the first step leading to results is for people to get together. Concentration and coöperation are our first remedies. As Dr. Van Hise has said: "Through concentration we may have the economic advantages coming from magnitude of operations. Through coöperation we may limit the wastes of the competitive system."

Take coal, for instance. The late Dr. Holmes, of the Bureau of Mines, has pointed out that the strenuous competition and low price at which coal was produced made it impossible for the operators in certain portions of the country to mine the maximum amount of coal from the seams that they worked. In their competitive struggle to maintain a place and to keep out of bankruptcy, they were obliged to mine only the easy places in the seam, leaving the rest in the ground to be perhaps never utilized. Dr. Holmes is on record as saying that 40% of the coal is wasted in this way.

Federal experts in the forest service have pointed out that in the lumber industry practically the same conditions exist as in the coal industry. The best timber only is taken, leaving other grades to decay and to afford fuel for forest fires.

In petroleum and natural gas a criminal waste is going on. A paper read at the recent meeting of the American Mining Congress showed that at the present rate of consumption of petroleum all the known reserve resources of the United States will be exhausted in about 30 years. The author of this paper graphically calls attention to this subject as follows: "I have seen millions of cubic feet of natural gas wasting in the air—gas so rich in gasoline that it dripped from the trees like an April shower. It has been testified before the Corporation Commission of Oklahoma that ordinary methods leave from 25 to 85% of the oil in the ground. The state metallurgist of California estimates the loss by evaporation of oil as 25%."

In a hearing before the Senate Committee on Public Lands it is shown that the companies which exploited the famous Glen Pool of Oklahoma spent over $11,000,000 in drilling wells, when if the whole pool had been exploited by one producer who would have handled the work properly, all the oil could have been obtained for a little over $3,000,000.

Farm products and forests go through a process of perpetual renewal, but the mineral resources of the world cannot be renewed and are absolutely limited. No mine has a lease of life in perpetuity. These valuable things are laid on a thin crust of the earth's surface. Let us, therefore, get together, and under Government supervision, and perhaps control, we should secure freedom for fair competition, elimination of unfair practices, conservation of our natural resources, fair wages and reasonable prices. The anti-trust laws were never designed to act contrary to the public welfare. These laws have been framed to prevent abuse, to conserve the public interest, to prevent private monopoly. The Supreme Court has read into the Sherman Act the rule of reason. Let Congress go farther and apply the rule of reason to these primary natural resources by exempting them absolutely and entirely from the provisions of the anti-trust acts, putting these resources aside as great national assets, and through the Federal Trade Commission, or some other Government agency, permitting or even enforcing, concentration and coöperation so that the present wild and untamed rush to make money while the sun shines will give place to safety first, looking next at fair profits, fair wages, fair play and the permanent and increasing prosperity of the whole people.

Ferroalloys in Canada

Ferrosilicon and ferrophosphorus were produced in Canada in electric smelting plants during 1915, the latter in small quantities only, according to a report in *Canadian Engineer*, Jan. 4, 1917. Ferrosilicon, 50%, 75% and 85%, was made at Welland, Ont., by Electro-Metals, Ltd., and ferrophosphorus at Buckingham, Que., by the Electric Reduction Co., Ltd.

The total production of ferroalloys during 1915, accurate figures for which are just now available, was 10,794 tons, as against a production of 7524 tons in 1914 and 8075 tons in 1913 and in 1912 was 7834 tons.

Wilhelm Merton*

Wilhelm Merton, the founder and chairman of directors of the Metallgesellschaft, of Frankfort, a/M., died suddenly in Berlin on Dec. 15, 1916, of heart-failure, in his sixty-ninth year. He was the third of the four sons of Ralph Merton, born in England, who in the first half of the nineteenth century settled in Frankfort, and married the daughter of Philipp Abraham Cohen, a metal merchant of that city. Ralph's children, although born in Germany, followed the nationality of their father, and were in law British subjects. The eldest returned to England, and in 1860 founded the firm of Henry R. Merton & Co., with which two of his brothers, but not Wilhelm, afterwards became associated. Wilhelm also served a short apprenticeship in the London business, but in the early '70's he returned to Frankfort, and became a partner with his father in the firm of Philipp Abraham Cohen, which was converted in the year 1881 into a limited liability company, the Metallgesellschaft, with a capital of £100,000, now £1,000,000.

The English business of the Mertons, now a company under the style of Henry R. Merton & Co. (Ltd.), has always been independent of the Frankfort enterprise, although until the beginning of the war it had intimate business associations with it, but in the course of the year 1916 the proprietary interests of the two businesses were entirely severed by an exchange of shares, and the London company is now an entirely British-owned undertaking.

Wilhelm Merton, who acquired German citizenship, spent almost the whole of his business life in Frankfort. He is survived by his wife, three sons, and three daughters. Of the sons, the eldest, Alfred Merton, is a director of the Metallgesellschaft, and two, Walter and Richard, hold the rank of captain in the German Army, and are now at the Front. Wilhelm Merton himself had been engaged on war work for the past two years, and it is said that he coöperated actively in the drafting of numerous regulations dealing with the economic management of the war, and that "his advice caused many mistakes to be avoided," although his name was never publicly mentioned with his work. In fact, the practice of self-effacement appears to have been one of Wilhelm Merton's most striking characteristics, and in business circles he was very little known except as the head of three great metal firms, the Metallgesellschaft, the Metallurgische Gesellschaft, and the Gesellschaft fuer Metallwerte of Bâle. He was also a director of the Frankforter Bank and of the Deutsche Gold und Silber Scheideanstalt.

Frankfort loses in Wilhelm Merton a model citizen. Early in his career he began to give liberally to the poor and to busy himself with schemes for the alleviation of their lot. This work culminated in the year 1896 in an Institute for the Public Welfare, which aimed not only at helping the needy individually, but in spreading the sense of social duty and knowledge of social problems among the official and merchant classes. Five years later he founded the Frankfort Academy for Social and Commercial Sciences, and he followed this up by endowing the first Chair of Educational Science in a German university. Personally he was unassuming to a degree, a generous and enlightened employer, and a man of wide sympathies and many private friendships.

*Excerpts from an article in the "Ironmonger," Dec. 30, 1916.

The Zinc Industry in Canada

TORONTO CORRESPONDENCE

The future of the Canadian zinc industry has become a question of increasing importance owing to the changed conditions brought about by the war. The production of zinc ore in Canada has never been large, and all ores have hitherto been exported for treatment, and zinc and its products imported. The feasibility of zinc smelting in Canada was considered by a special commission appointed in 1905, which reported favorably, but no practical result ensued.

Alfred W. G. Wilson, of the Canadian Department of Mines, makes a report[1] in which he gives the results of an investigation into the costs of the raw material, required in the industry, based on information obtained in the principal smelting centers of the United States and the zinc mines of British Columbia during the summer of 1916. It also deals with the prospective output of the British Columbia zinc mines, tariff conditions, and the production of electrolytic zinc in Canada. The conclusion of the author is that, so far as the actual operations of a smeltery are concerned, the cost of smelting in the Crow's Nest Pass area or on the Pacific coast would not be made greater than in the Middle Western States; where coal is used for fuel, and with coöperation between all the interests concerned, it could be carried on in Canada with equal or greater economy than elsewhere. The cost in the natural-gas areas in Canada would be greater than in corresponding areas in the United States, but not at all prohibitive. The writer is in accord with previous investigators in concluding that it has not been demonstrated that British Columbia silver-lead-zinc mines are capable of producing enough high-grade zinc concentrates to support a smeltery operating on the Belgian or any similar process. An independent zinc-smelting plant would be handicapped for lack of a silver refinery and would have to consign all lead and silver constituents to the smeltery at Trail or to Helena, Mont., thus curtailing its profits.

The establishment of the new electrolytic plant at Trail and the proposed establishment of the plant at Nelson by the French Complex Ore Reduction Co. have materially altered the situation with respect to a market for British Columbia zinc ores. The process used at Trail is still undergoing development, and the Consolidated Mining and Smelting Co. is not in the market to purchase zinc ores, having an ample supply of its own. As soon, however, as initial difficulties are overcome, it is their intention to purchase ores suitable for treatment in their plant and subject to the market demands for spelter.

The establishment of a zinc-smelting plant in British Columbia at present does not appear feasible on account of the inadequate supply of ores and suitable labor and the high cost of structural materials. Moreover, the retorting process is not especially adapted to treat the complex silver-lead-zinc ores comprising the bulk of the British Columbia output, whereas developments now going on in electrolytic processes give promise of a solution of this problem. If these processes are successful, it may prove to be possible to treat some ores locally in plants of smaller unit size than are practicable in smelting by a retort process.

[1]"Report on the Production of Spelter in Canada." By Alfred W. G. Wilson. Pp., 60. Canadian Department of Mines, Ottawa, 1916.

Editorials

The Rally from the Setback

Vigorous efforts are being made to revive the boom in the copper stocks that burst in December. Money is easy, and inflation is in the air. The tip is passed around that the bankers have said "let 'er go." The Wall Street organs suddenly blossom out with rosy stories of the fabulous prospects of this or that company. The Allies are reported to be opening negotiations for another half-billion pounds (or is it to be a billion this time?) of copper, which will absorb all the expected production for how long, Heaven only knows. These are the familiar operations of setting the stage. But for some reason or other the curtain does not go up, the play does not begin. Perhaps it will, after some further delay, but we do not think it will be so exciting as the melodrama of November, which turned to tragedy in December.

Nevertheless, there has been a real "comeback" in some of the metal markets, especially copper. The position of this metal is unparalleled. Toward the middle of December there was a good deal of reselling by consumers. At first there was some resistance to the decline in the buying of other consumers who had not covered their first-quarter requirements and who had decided, when copper reached 32 @ 33c., to hold off and take their chances. When prices first began to go off, they made some purchases, but when they found how insistent some of the resellers were, they pulled out again, and the decline then became rapid. But around 27c. the price was below what most of the resellers, themselves, had paid, and then they quit offering, not being disposed to take a loss; seeing which, the consumers, who were still short, together with speculators, began to cover and we had a sharp rally. The big producers were, of course, and still are out of the market, being sold out.

It is a curious situation. The January-June production is nearly all sold at about 26½ @ 27c. Following the consummation of the bulk of that business, we have had monthly averages above 30c. on relatively small business. There are many interests—both buying and selling, consuming and producing—who would like to depress the price, but at present nobody can put his hands on the copper to do it with. When anybody gets small supplies, they are snapped up by uncovered consumers. Things will have to come more into equilibrium before the market will be able to exhibit a definite trend. At present nobody is looking for a resumption of the advance that halted in December, nor on the other hand for an early collapse from the present exalted level. An important recession is hardly to be looked for until supplies become more liberal. The recent blockade of one of the great refineries by a strike did not tend to alleviate the tightness.

A very great factor, of course, will be the action of the Allies in providing for their requirements for the second half of 1917. There is not much doubt now that they are going to be obliged to buy a large quantity of copper, but when and how are the questions. The recent reports of negotiations having been opened were false and apparently were based on mischievous fabrications. Of one thing we may be certain; namely from all accounts from abroad, wisdom is now looming large in the commercial affairs of the British authorities, and they are not likely to be bullied into anything.

Lead also is very strong, the producers being practically sold out for a period ahead that is long for this metal, in which future selling does not ordinarily prevail, although it is short in comparison with the copper order books. Speculators who were bearish on lead, on the theory that the clock had struck twelve for everything, were obliged to reverse themselves when they found that the complexion of this market, in common with others, had changed.

Similarly was there a recovery in spelter, but the position of this metal is different from the others in that there exist stocks in the hands of smelters. However, consumers continue indifferent, and the conspicuous absence of British and French buying is beginning to furnish some food for thought. Yet many producers will let stocks accumulate, hoping for a further "comeback" before they will sell. Those who are bearish will doubtless try quietly to place spelter rather than exhibit any aggressive disposition. Stocks will have to accumulate more before there will be any occasion for anybody to think of making a price that will move them.

Mining Law Revision

The agitation for revision of the mining laws of the United States has made important headway. The mining organizations of the country united in asking Congress to appoint a commission to draft new legislation. The Senate was willing to accede to that request, but the House of Representatives was not. This was a year ago. Steps were then taken, still under the leadership of the Mining and Metallurgical Society of America, to prepare a draft for a new mining law by common coöperation among mining men, with the view of framing a mining men's bill, and much was done in drawing out expressions of opinion for that purpose. The Mining and Metallurgical Society then invited the assistance of the United States Bureau of Mines, which has now been obtained.

In order to carry out this idea, the Director of the Bureau has requested a committee of its consulting engineers, consisting of J. Parke Channing, James Douglas, J. R. Finlay, John Hays Hammond, W. R. Ingalls, Hennen Jennings and L. D. Ricketts, to try to work out a new law that will be satisfactory to Congress and the mining industry in general. Thus we get back to the commission idea that has been consistently the wish of the mining organizations.

The committee that has been appointed is the same that drafted model legislation for the prevention of accidents in metal mines, published as Bulletin 75 of the

Bureau of Mines, with which the mining industry is very familiar, its code having been adopted as the basis of laws in several of the states west of the Rocky Mountains. Mr. Jennings and Dr. Ricketts, two very distinguished engineers, have been added to the old committee. The appointment of the enlarged committee received the formal indorsement of the council of the Mining and Metallurgical Society of America. Without any doubt the committee will proceed in the same way that it did in its former job; that is, taking the public into its confidence, publishing tentative drafts from time to time, and inviting coöperation and criticism as it goes along. The committee will, of course, have proper legal advice. As the *Journal* has remarked previously, it is better to put this work in the hands of a committee of engineers and let them get the legal assistance that they need than to have a committee of lawyers, hoping that they will seek engineering advice. We feel that the step of the Mining and Metallurgical Society of America and the United States Bureau of Mines, acting jointly in the appointment of this committee, will meet with general approval.

Leasing Again at Goldfield

The fine flair of the "leaser" for ore is again to have its opportunity in the mines of the Goldfield Consolidated company in Nevada. This brilliant skyrocket of the gold-mining world is now reduced to a dull-red glow, and has appealed to the "ore scouts" of the industry to save it from extinction. The Consolidated company, after enjoying a remarkable success, attaining suddenly the position of the world's premier gold producer and paying $29,000,000 in dividends, has lately been earning a precarious existence while vainly hunting for the bonanza ore of former days, and is now apparently reduced to the low estate of appealing to "leasers" to save it from oblivion. Will they be able to accomplish this? Many in the district are hopeful, but probably no one can make a prediction that will be anything more than a guess Some gold districts have long outlasted their apparent span of life—witness Cripple Creek, still producing and with recent important discoveries at depth.

At the last meeting of the board of directors of Goldfield Consolidated, it was decided to throw open certain portions of the mines to lessees on the following terms: Profits to be divided equally on a basis of a net recoverable value of 90% of the gold at $20 per oz., after deducting $4 per ton for transporting, sampling and milling; the company to hoist the ore free of charge and to furnish all tools and supplies except powder. On outlying portions of the company's estate, not connected with the main workings, a modified form of lease is to be granted.

On the basis of late company returns at Goldfield, the lessees will not make their salt, but as in many other mines, it is anticipated that the superior "nose" for ore of the "leaser" will enable him to thrive where corporate direction—without the stimulus of individual gain—was impotent. Inasmuch as the Goldfield Consolidated group of mines may be said to have been made by the "leaser," it is fitting that he should have the opportunity of seeing if he can rejuvenate the properties. It will be exceedingly interesting to follow the results of this experiment and observe whether he can again put these mines in the dividend list. The most promising discoveries made in the Goldfield district of late have been in what may be termed the newer properties, while the established producers have practically exhausted their reserves without developing any new ore of much value. The Atlanta company has just arranged to have its low-grade copper-gold ore treated in the Goldfield Consolidated mill on a custom basis.

The Randall Rider Killed

The Post Office Appropriation Bill, H-R-19,410, was passed in the House of Representatives, Washington, D. C., on Tuesday, Jan. 16. Section 10, known as the "Randall Rider," which provided that newspapers, magazines and other publications regularly admitted to the mails as matter of the second class, when mailed by the publisher, shall hereafter be subjected to a change in rates of postage under a zone system now applying to parcel post matter, was stricken from the bill.

This new legislation, had it received the approval of Congress and ultimately become law, would have imposed a tremendous burden upon most subscribers, and it is with great relief that we announce that Congress, in its wisdom, has not seen fit to impose this burden at this time.

The Webb Bill

Doubt is growing about the passage of the Webb Bill. This having been already passed the House of Representatives, having the indorsement of the Federal Trade Commission, and furthermore, having the indorsement of the Administration, a few weeks ago it seemed that it would be only a matter of time before it would be passed by the Senate. However, it appears now that several of the lawyers on the Senate Commerce Committee argue that this bill, which is intended to permit coöperation among manufacturers for foreign trade, is unnecessary, there being no prohibition in the Sherman Law against combinations for export trade. To be sure, that is what many persons think, but there is doubt, and doubt in the minds of business men has the same effect as legal prohibition. The passage of the Webb Bill by the Senate would remove it. The mulling over this question is simply another example of the way that lawyers of a certain type mess things up in our public life.

An interesting innovation in the management of machine drills under ground has been made at the Franklin mine, in the Lake Superior district. As many as eight machine drills are run in a row all supervised by one expert mechanic. This scheme could well be copied by other mines that have stopes sufficiently large to justify that number of drills. The advantages are obvious; the bunching of machine drills pleases the miners, who like company in their work, and it saves on supplies, and also in the matter of time in the correction of any minor difficulties that may arise. Although the machine runner in the Lake Superior District is of a superior type, nevertheless he cannot be expected to be as good a mechanic as he is a drill runner, and therefore the services of a mechanic at hand are of great advantage. Not the least benefit of such an arrangement is that it reduces to a minimum the likelihood of a drill runner losing his temper and hitting his drill with a sledge-hammer, whereupon it immediately becomes a candidate for the drill hospital.

BY THE WAY

The importation of foreign automobiles, motorcycles and parts thereof into India is prohibited from Jan. 1, 1917. It is understood that this is occasioned by the shortage of gasoline in British India and that no shipment exported from the United States or other foreign country after Jan. 1 will be admitted.

For the eleventh consecutive year John Hays Hammond is to be president of the Rocky Mountain Club, of which he was one of the founders and of which William B. Thompson is vice-president. At the annual dinner at Delmonico's, on Jan. 9 estimates of the wealth represented, were in ten figures. The Club is to have a new $1,000,000 clubhouse between Fifth and Sixth Ave., it was announced at the banquet. John Hays Hammond said that an attempt would be made during the year to double the present membership of 1000.

A mining engineer writes us on the letterhead of a mining company as follows: "I resigned from this company because they were using too much poetic license with my reports and trying to place ore in sight and money in the treasury through the instrumentality of prospectuses instead of by the drill. There are many good properties idle now because of such methods and such promoters. We need capital, but it must be legitimate." These are correct ideas, and the action of our correspondent exhibits courage of convictions and the flavor of the honor that mining engineers have in their profession.

It is as hard to get admission to the Nichols Copper Co's plant as to enter some of the proverbial places. Only men on the payroll may enter the gate without passes, and even the staff may not take accredited visitors by the gate without delivering for them a pass to the gatekeeper. One day Dr. Nichols started to enter the plant and was asked for his pass by the gatekeeper. He hadn't any, but said, "Oh, I am Dr. Nichols." The gateman replied, "That doesn't mean anything to me." "But I am president of this company," said Dr. Nichols. "Well," said the gateman, "that doesn't get you in, and the only thing that will is a pass from the office." Dr. Nichols went over to the office, got the necessary pass, and incidentally ordered the gateman's wages increased.

To precipitate oneself together with a car and two tons of ore down a 500-ft shaft is an adventure, says a Morenci miner, frought with dire possibilities, and, in the event one survives the experience with only two ribs fractured, is calculated to strengthen one's conviction that humans have a particularly secure hold on life. I say that is the way it looks to me. Many thousands of cars of ore had Cristobal Cortez, of Santander, trammed and dumped into the skip, and never a time had he known the skip, once it was placed, to move until he had dumped the car and pulled the bell cord. So complete was Cristobal's faith in the automaticity of the operation that he expended no energy in ascertaining if such was the behavior of the skip at this particular time. It wasn't. The skip for some reason had been taken away. As a consequence the Spaniard pushed the car straight into the shaft and accompanied it forthwith. A few feet down, however, the car spilled the contents in such fashion as to wedge itself hard and fast between the timbers. Hence only the broken ribs.

A prominent (unnamed) director of Utah Copper Co. is quoted by the *Boston News Bureau* with reference to flotation operations at that company's mills. The Boston paper, in its issue of Jan. 18, says: "Since the adverse decision of the Supreme Court in the Minerals Separation litigation whereby the copper companies which have not taken out licenses are prohibited from using less than 1% of oil in the flotation process, Utah Copper has been making some extraordinary recoveries in the use of a fraction over 1% of oil. Anything over 1% does not fall within the prohibitions of the patent. The director in question asserts that the recoveries are just as high as when a very small percentage of oil was used and that by cheapening the grade the increased quantity of oil does not materially affect the cost." This is very important—if true.

The man who holds a dying nation in his arms, says the New York *Tribune*, Jan. 22, came down the gangplank of the liner "Philadelphia" into New York City yesterday. He stood for a moment, silent in the hurry of disembarkment. His tired eyes looked through the gloomy arch of the pier out upon a snowswept bit of the richest city in the world. He was Herbert C. Hoover, of the Belgian Relief Commission—Hoover of Belgium—head of the great organization that works unceasingly to keep the beaten souls of a people in their starved bodies. He has come to America once more on the same endless mission—to ask that the United States do her share in supplying a part of the $200,000,000 which Belgium must have or perish. There are new lines about the man's eyes, for they have looked on suffering every day for months. He is thinner than when New York saw him last, and there is more weariness in his face. That has been stamped upon it by the woes of 5,500,000 people, the 3,500,000 Belgians and 2,000,000 French which he and his commission, by the grace of the German Empire, are allowed to keep from starving to death. Since the beginning of the war he has toiled continually, and all this time the fight has been going against him. The mighty efforts of the commission have saved Belgian bodies from dying. They have not been able to lift up the spirits of a people that Germany is trying to crush. "The situation in Belgium is the worst since the beginning of the war," he said. "I have come home to ask Americans to do their share in raising between $150,000,000 and $200,000,000 needed to feed the destitute." Asked what he regarded as the greatest accomplishment of the American commission in the last year, Mr. Hoover replied: "One-fourth of a million school children have received an extra meal daily from the commission. The meal consists only of a meat hash and bread, but it has helped greatly to increase the attendance of the schools. Previously the children remained at home, as their parents were afraid that they would go hungry if allowed to depart from the parental fireside. Now, with their extra meal guaranteed, the parents let them attend classes."

Personals

Fred Hellmann is back from Chile.

H. H. Knox has returned from Russia.

Prof. Waldemar Lindgren is going to South America for four months.

Herbert C. Hoover arrived this week. He will be here for about a month.

A. E. Wheeler, formerly in the Belgian Congo, is now at Great Falls, Mont.

W. I. Higgins is now operating the Billenberg & Higgins mine, near Twin Bridges, Mont.

Hon. Esioff L. Patenaude, of Montreal, has been appointed Canadian Secretary of State and Minister of Mines.

Ellard W. Carson has been made superintendent of the Oceanic Quicksilver Mine, at Cambria, Calif., and has entered upon his duties there.

James E. Strong has been appointed general superintendent of mines for the Gloss-Sheffield Steel and Iron Co., succeeding the late J. G. Moore.

D. C. Bard has become a member of the geological department of the Chicago, Milwaukee & St. Paul Railway Co., with headquarters at Seattle, Wash.

Charles M. Hanson has been made chairman of a committee on accident prevention and workmen's compensation of the National Association of Manufacturers.

J. E. Hughes, formerly with El Oro Mining and Ry. Co. in Mexico, sailed Jan. 19 for Santiago, Cuba, where he has accepted a position with the Cuba Copper Co.

Carl J. Trauerman, of Butte, Mont., is spending a month in Chicago, Pittsburg and New York and can be reached at A. I. M. E. headquarters, New York City.

C. G. Tarkington has resigned his position with the Snyder Electric Furnace Co., Chicago, and is now in charge of a branch office of the Haynes-Stellite Co., at Pittsburgh, Pa.

Viscount Tevashino Inovyi, professor of mining in a government school in Tokio, Japan, is in Butte studying mining, milling and smelting methods in Butte and Anaconda.

H. M. S. Tuckwell, chief engineer of the London office of the Tata Iron and Steel Co., India, arrived in New York on Jan. 16 for a few weeks' stay in the United States.

R. K. Stockwell, for the past five years superintendent of construction for the Braden Copper Co., Chile, will represent the Robins Conveying Belt Co., in Salt Lake City, Utah.

Premier Brewster of British Columbia has returned to the Pacific Coast after a visit to Eastern Canada, where he has secured financial assistance for the development of the British Columbia mining industry.

W. W. Charles has severed his connection with the Tonopah Mining Co., and will establish his own business in consulting work. Mr. Charles was in charge of placer operations in the Breckenridge district, Colo., and afterward went to South America for the Tonopah company.

Robert Linton has been made first vice-president and assistant to the president of the North Butte Mining Co., and will undertake the duties of his new position on Feb. 1. Mining and development work will be under his direct charge. He will make his headquarters in New York.

J. A. Carpenter, recently in charge of the metallurgical department of the West End Consolidated company, of Tonopah, Nev., has accepted the appointment as general superintendent for the Nevada Packard Mines Co., of Rochester, Nev. He will undertake his new work immediately.

C. W. Fielding, chairman of the Rio Tinto Co., Ltd., has been appointed chairman of the Metals and Materials Economy Committee under the British Ministry of Munitions, which will consider and suggest the action necessary to secure economies in metals and materials as regards their use in munitions of war, taking into consideration matters affecting design, methods of purchase, stocks, import, distribution and control; with powers to take such evidence as may be necessary both from the departments of the Ministry and from manufacturers.

Obituary

Ernest O. Jacobsen of 304 West Seventy-first St., Secretary and Treasurer and one of the founders of the National Zinc Co., died on Jan. 24, in the Post-Graduate Hospital, in his fifty-first year. He was born in Liverpool, and came to this country 35 years ago. Mr. Jacobsen was formerly private secretary of the late Elliott F. Shepard, later founding the firm of E. O. Jacobsen & Co., which was merged into the National Zinc Co. five years ago.

O. A. Palmer, well-known mining engineer and mining expert of Salt Lake City, died Jan. 13 of hardening of the arteries. Mr. Palmer was consulting engineer for the Ontario mine, at Park City, during this property's most productive period. The Ontario drain tunnels were conceived and driven under his direction. Mr. Palmer was also consulting engineer for the Centennial Eureka and Eureka Hill mines at Tintic up to about 1895. He made a specialty of mining law-suit work, and was prominent in a number of important suits in this section and in Montana and Idaho. Services were held at the Masonic temple.

Col. Alexander M. Hay, a prominent mining man died at Haileybury, Ont., on Jan. 20, from pneumonia, at the age of 56 years. He was born in Scotland and came to America in 1890. He was engaged in various mining enterprises in the United States, Canada and Mexico and came to the Cobalt district in 1905, with the development of which he has been closely identified. He was president of the Trethewey, Northern Exploration and McIntyre Porcupine companies and a director of various other mining and industrial corporations. Until about two weeks before his death Col. Hay was actively engaged in looking after the affairs of the McIntyre company. He suffered from a slight indisposition, but visited the mine to procure information for the quarterly report of the company, and while there contracted the illness which proved fatal. Col. Hay was widely known and much esteemed in commercial circles. He leaves a widow but no family. It is understood that his demise will not halt the pending consolidation of the McIntyre, Jupiter and McIntyre Extension (old Pearl Lake) properties.

Societies

American Institute of Mining Engineers has appointed a committee, consisting of Hennen Jennings, G. S. Williams and G. E. Walcott, to act as delegates at the Congress of Constructive Patriotism, to be held at Washington, D. C., Jan. 25 to 27, 1917.

Mining and Metallurgical Society of America has appointed Arthur S. Dwight, Hennen Jennings and George Otis Smith, as delegates to the Congress of Constructive Patriotism, to be held at Washington, Jan. 25 to 27, under the auspices of the National Security League.

American Institute of Mining Engineers. Colorado Section, held its annual dinner and meeting at the University Club, Denver, Jan. 15. The following officers for 1917 were elected: Chairman, Charles Loughridge; vice-chairman, George M. Taylor; secretary-treasurer, Fred Carroll; other directors, Fred A. Bostwick and P. M. McHugh. Dr. L. D. Ricketts, president of the parent institute, addressed the meeting by long distance phone. Howard C. Parmelee, president of the Colorado School of Mines, spoke upon "Flotation Exposed and Explained," and Thomas B. Stearns read a paper upon "The Latest Practice in Cyanide Milling." Each of these papers described features of the respective processes that had never before been made public.

Lake Superior Mining Institute has made arrangements for its 21st annual meeting, which this year will be held at Birmingham, Ala., Mar. 13, 14 and 15, 1917. The invitation was extended to the Institute through the courtesy of C. T. Fairlaim, manager for the Republic Iron and Steel Co. Members and guests will assemble in Chicago on Saturday, Mar. 10. Headquarters will be at the Congress Hotel. A special train, to be furnished by the Queen & Crescent Route, will leave from the Illinois Central Station, and arrive in Cincinnati at 8:00 Sunday morning; departing at 8:25 for Chattanooga, Tenn., arriving there about 6:25 p.m. The special train will be parked at Chattanooga and sleeping cars will be occupied for the night. On Monday, Mar. 12, the train will leave Chattanooga in sightseeing cars for trip through Chickamauga National Military Park, Missionary Ridge and the National Cemetery. Returning the party will reach Patten Hotel about noon, where luncheon will be served. At 2:00 p.m. the party will leave Patten Hotel for the trip to the summit of Lookout Mountain in sight-seeing cars. Trip will be completed and return for dinner at 5:00 p.m. The train will leave Chattanooga about midnight for Birmingham, arriving there at 6 a.m. Tuesday, Mar. 13. A very interesting program is being outlined for the following three days by the mining men of the Birmingham district, for the entertainment of the visitors from the North and complete itinerary will be announced later. Headquarters will be at the Tutwiler Hotel.

Industrial News

Chicago Pneumatic Tool Co. held the annual convention of its sales and factory organizations at the Great Northern hotel, Chicago, Jan. 11, 12 and 13, 1917. The program included a trip to the company's plant at Chicago Heights.

United States Cast-Iron Pipe and Foundry Co. has been awarded a contract to supply 60,000 tons of pipe for the Obras Sanitarias de la Nación, of Buenos Aires, Argentina, according to a note published in "Commerce Reports." The contract involves about $3,500,000.

The Dorr Co., engineers, with offices at Denver and New York, pay to each employee of six months or more service, a bonus equal to 15% of his monthly salary, as an offset to the high cost of living. The arrangement is subject to termination at the end of six months from Jan. 1, 1917.

Westinghouse Air Brake Co. has made arrangements for the merger into it of the Union Switch and Signal Co. and practically all of the Switch and Signal company's stock has been deposited in assent to the plan. Directors of the Air Brake company have called a special meeting of the stockholders for Mar. 15, 1917, to ratify the merger and to approve an increase of the capital stock from $20,000,000 to $30,000,000, to finance the transaction. Out of the increased capital it is proposed to declare a stock dividend of 20% to all holders of Air Brake stock, including those exchanged for the Switch and Signal stock.

Yuba Construction Co. has leased the plant of the Benecia Iron Works, situated on deep water on the north shore of Carquinez Strait, to supplement the Marysville shops and increase the capacity of the manufacturing department of the company. The plant at Marysville has for some time been taxed beyond its normal capacity with orders for Yuba tractors, plows and pumps in addition to the large demands for design and manufacture of dredge machinery and material to keep pace with the construction department in the field. The Yuba Construction Co. is essentially a manufacturing concern; the construction department is employed solely in the assembling of material and machinery in the field and constructing dredges and other machines designed and manufactured at the company shops. The Benecia plant will be chiefly employed in the manufacture of tractors, plows and pumps. The placer dredges will continue to be designed and built at the Marysville manufactory. The Benecia plant occupies about 20 acres of ground and includes a foundry, forge and machine shops, wood shop and warehouses. The situation, between the head of San Pablo Bay and the confluence of the Sacramento and San Joaquin Rivers through Suisun Bay with the strait, provides not only for deep water transportation but commands both water and rail outlet to interior points in California and rail connection with points in adjoining states.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Aluminum Alloy. William A. McAdams, Bay Shore, N. Y. (U. S. No. 1,212,374; Jan. 16, 1917.)

Charge Car. John E. Greenawalt, Denver, Colo. (U. S. No. 1,212,629; Jan. 16, 1917.)

Concentration—Separating Finely Divided Ore Mixtures in Vacuum Separating Vessels or Chambers. Friedrich Arthur Maximilian Schiechel, Frankfort-on-the-Main, Germany. (U. S. No. 1,212,566; Jan. 16, 1917.)

Concentrating Table. Pneuumatic. Clarence Q. Payne, New York, N. Y. (U. S. No. 1,212,393; Jan. 16, 1917.)

Drill Sharpening Machine. James H. Sinclair and Harry L. Sinclair, Denver, Colo. (U. S. No. 1,212,576; Jan. 16, 1917.)

Mining Machine. Carl J. E. Waxbom, Columbus, Ohio, assignor to the Jeffrey Manufacturing Co., Columbus, Ohio. (U. S. No. 1,212,717; Jan. 16, 1917.)

Mining Machine. Edmund C. Morgan, Morgan Park, Ill. (U. S. No. 1,212 382; Jan. 16, 1917.)

Nickel Ores—Treatment of. Frederic A. Eustis, Milton, Mass. (U. S. No. 1,212,334; Jan. 16, 1917.)

Revolving Screen and Method of Screening. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York. (U. S. No. 1,212,179; Jan. 16, 1917.)

Smoke Treatment—Method of Removing Sulphur Dioxide from Metallurgical Smoke and Similar Gases. Frederic Augustus Eustis, Milton, Mass. (U. S. No. 1,212,199; Jan. 16, 1917.)

Sintering Apparatus. Frederic A. Eustis, Milton, Mass. (U. S. No. 1,212,333; Jan. 16, 1917.)

Steel Treatment—Apparatus for Treating Steel Ingots. Edward J. Flynn, Jr., Woodlawn, Penn. (U. S. No. 1,212,470; Jan. 16, 1917.)

Tungsten—Process for Producing Homogeneous Bodies of Chemically-Pure Tungsten Metal of Any Desired Shape. Otto Voigtlander and Hugo Lohmann, Essen-on-the-Ruhr, Germany. (U. S. No. 1,212,426; Jan. 16, 1917.)

Editorial Correspondence

SAN FRANCISCO—Jan. 18

In Big Bend District, near Yankee Hill, in Butte County, development by J. A. and I. N. Clark has disclosed a 20-ft. gold-bearing vein near the Surcease mine. J. A. Clark discovered and developed the Surcease, now owned by John Kinkaid, which is coming into position as a producer. There are other showings of gold-bearing ores in this basin, situated in the bend of North Fork of Feather River. The Clark brothers have worked alone there for several years in the belief that the district will show good mines if money and labor are properly expended.

California Oil Production in December amounted to 7,935,473 bbl. from 7333 wells. Total shipments were 9,813,459 bbl., reducing the stocks on hand from 45,914,181 bbl. at the end of November to 44,036,190 bbl. at the end of December. Comparisons with November show a daily decline in production of 7226 bbl. and a daily increase in shipments of 6555 bbl. The December well completions totaled 56, which yielded an initial daily production of 15,746 bbl. During the year 1916 the demand exceeded the supply by an average of 35,822 bbl. daily and reduced the stocks on hand at the end of 1916 by 13,110,861 bbl. The daily average production of 1916 exceeded that of 1915 by 5493 bbl. But the daily average shipments increased 36,536 bbl. The total production in 1916, as recorded by the Standard, amounted to 91,822,362 bbl. The production in 1915, as reported by the State Mining Bureau, was 91,146,620 bbl.

BUTTE—Jan. 18

Proposed Taxation of Montana Mining has become a universal topic of conversation in Butte. The mining industry of Montana is once more threatened through hostile, shortsighted, and excessive taxation that has been proposed in the state legislature, convened at Helena on Jan. 1. One bill, the most radical of all, proposes to levy a tax of 6% on the value of all metals taken out of the ground in Montana. This and other proposed measures have aroused every mining company and miner, as well as thousands indirectly connected with the industry in the state. It has led to the organization of the mining companies and mining men of the entire state and vigorous steps are now being taken to prevent the success of the plan to burden the mining companies of Montana with this additional taxation. A meeting was held on Jan. 15, at the Silver Bow Club in Butte, which was attended by representatives of 28 mining companies and as many more individual mining operators. Former Senator Lee Mantle presided and the object of the meeting was set forth by Cornelius F. Kelley, vice-president and managing director of the Anaconda Copper Mining Co., whose address was accepted as outlining the policy of the new organization. Senator Mantle was made permanent chairman of the organization, Attorney J. Bruce Kremer, Democratic national committeeman from Montana, the vice-chairman, and Charles Bocking, of the Butte & Superior company, secretary. An executive committee was named to take full charge of the campaign consisting of Cornelius F. Kelley, J. L. Bruce, general manager of the Butte & Superior company, W. L. Creden, general manager of the Davis-Daly company, Oscar Rohn, general manager of the East Butte Copper Mining Co. and George F. Shelton of the Clark mining interests. In addition to these a general committee was named on which are the following: Charles H. Lane, mayor of Butte; W. A. Clark Jr., manager of the Elm Orlu Mining Co. and Timber Butte Milling Co.; Paul A. Gow, general manager of the Tuolumne Mining Co.; Andrew J. Davis, president of the First National Bank; Norman Braley, general manager of the North Butte Mining Co.; R. M. Green, general manager of the Butte & Great Falls Mining Co.; F. M. Kerr, general manager of the Montana Power Co.; Alfred Frank, manager of the Mines Operating Co.; Sol Genzberger, secretary of the Butte & Zenith City Mining Co.; John Gillie, general manager of mines of the Anaconda company; H. C. Bacorn of the Greater Butte Mining Co.; L. O. Evans, general attorney of the Anaconda company; C. J. Kelly, president of the Daly Bank and Trust Co.; D. J. Charles, president of the Miners' Savings Bank, and a number of other prominent business and professional men of the city. A committee was also appointed to organize the mining interests outside the Butte district in Montana. This includes C. W. Goodale, president of the Barnes-King Development Co.; W. A. Clark, Jr.; Samuel Barker, Jr., of the mining-engineering firm of Barker & Wilson; Arthur V. Corry, of the engineering firm of Harper McDonald & Co.; Attorney Charles R. Leanard of the Barnes-King company; Oscar Rohn, J. L. Bruce, W. L. Creden and Norman Braley. This committee has already enlisted the active coöperation of the leading mining companies and operators in the Helena mining district in Lewis and Clark County, in the Montana section of the Cœur D'Alene district, in the cities of Anaconda and Great Falls where the big reduction works are located, in the Fergus County mining district in the Moccasin mountains, and in Granite County. The operators of the coal mines in southeastern Montana have also pledged their coöperation. The attack on the mining interests originated among the representatives from the eastern farming counties of Montana. They do not take into account the fact that the wages of the miners and laborers have advanced from $3.50 to $4.75 per day and that when conditions become normal again these mining companies will find it difficult in many instances to make profits enough to maintain the regular dividend rate. An additional fact brought out in the committee meeting was that only five of the 28 operating companies in Butte are paying dividends at all. While the mining industry has prospered, the farming industry has enjoyed a proportionately great prosperity. One of the emergencies that Montana must meet is the falling off in state, county and city revenues beginning in January, 1919, when the state-wide prohibition law goes into effect. It is for this emergency that some of the farmer representatives introduced the mining-tax proposition. The mining operators are confident that they will succeed in heading off the unjust measure as the labor element dependent on mining is also thoroughly aroused to what the proposed bill will mean to them in the loss of work and the reduction in wages.

Further Sinking at Shannon Mine was ordered this week by Barnes-King Development Co. This mine is the most promising of all the Barnes-King properties. It is in the famous Drumlummon district and the development on the upper levels has been of the most encouraging nature. The average of the ore mined at the Shannon in the month of December was $14.39 per ton and this included a large amount of low-grade ore from the dump that was taken out in the development work. A payment of $14,200 was made in December on the purchase price of the Shannon, reducing the amount still due for that property to $133,300. At the present rate of payment it will be next fall before final payment is made. The company has an advantageous contract by which the property is to be paid for from a part of the proceeds of the mine. The note indebtedness of the company incurred last summer is being rapidly paid off and at the rate of production during the last three months, it will be entirely wiped out before July. The Barnes-King company is getting into a satisfactory condition and is making good profits above mining costs. Dividends, however, are not likely until Shannon is paid for.

DENVER—Jan. 17

Radium Signs, luminous in the dark are to be made by the Cold Light Manufacturing Co. This corporation has been organized as a subsidiary of the Schlessinger Radium Co. with the object of manufacturing door plates, street signs, push buttons, watch and clock dials and similar objects that will be luminous in the dark. Its headquarters are in the Chamber of Commerce Bulding, Denver.

Shortage of Cyanide has become so serious in Colorado that it amounts almost to a famine, and unless the market relaxes soon a number of mines will be obliged to close down. The situation is keenly felt in the San Juan region. At least one new project (in the Alma district) is unable to start up its mill. A few large companies are running upon stocks of cyanide that were laid in a year or more ago in anticipation of this crisis. Telegrams have been sent by operators to the Colorado Congressmen urging their support of the Niagara Water Diversion bill.

Community Mining is exemplified in the Hope Tunnel project at Aspen. The company is composed almost exclusively of local stockholders, including, it is said, members of every family in town; the success of the enterprise therefore is of vital interest to everybody. Economy in every move is a consequence of this condition. Last year the tunnel was advanced more than 100 ft. per month and the objective ore-bearing measures are still several hundreds of feet beyond the breast. The company controls a large acreage in the best part of the district and the present price of silver acts as a strong stimulus for continued effort in 1917.

SALT LAKE CITY—Jan. 19

Metallurgical Research Division of the U. S. Bureau of Mines at the University of Utah is to receive several thousand dollars for the prosecution of its work. This money, provided by the Federal Government, is to be used exclusively for investigation looking to the extraction of potash as a byproduct. There is no process at present by which this can be profitably extracted from mined ore and the department will investigate this field. The tailings from copper mines in this state contain as high as 6% potash, which, however, is not water-soluble, but combined in silicate form. Experimental work will be started at once by J. C. Morgan, junior chemist, under the supervision of E. A. Wells.

Utah Railroad Co. is being organized by the United States Fuel Co.—a subsidiary of the United States Smelting, Refining and Mining Co.—to undertake the transportation of coal from mines owned in Emery and Carbon Counties. The company is arranging to take over the Utah Fuel Co. track between Provo and Thistle, at present operated by the Denver & Rio Grande and also to make use of trackage rights, agreed to by contract, over the Denver & Rio Grande between Thistle Junction and Castle Gate. According to the contract a 12 months' notification is necessary and the Utah Railroad Co. will not begin operation until Nov. 1 of this year. The new company will also take over the Southern Utah railroad of the Fuel company, which affords transportation for the mines at Price. Arrangements have been made with the Salt Lake Route for transportation from Provo into Salt Lake. The coal mines at Sunnyside and at Scofield will remain as at present tributary to the Denver & Rio Grande. The new railroad company will build yards, roundhouse, coal chutes, water tanks, etc., at Provo, and shops and terminal facilities at Hiawatha. An order for 1500 all-steel gondola coal cars has been placed jointly with the Salt Lake Route, and new freight engines will be installed by the Utah Railroad Co. Traffic will be entirely in coal, though it is possible some passenger trains will be run for the benefit of employees.

LEAD, S. D.—Jan. 18

The Water-Right Case now before the circuit court of Lawrence County is of vital interest to Homestake Mining Co. That company and 300 other parties are made defendants in a case brought by Joseph Cook, a farmer residing on Spearfish Creek. Cook claims that in dry seasons other farmers above him, and the Homestake Mining Co. take all of the water, and his crops suffer through lack of irrigation. He claims prior right. Homestake takes the water from near the head of Spearfish and pumps it across the divide, using it in the mills at Lead and selling it for domestic supply both of Lead and Deadwood.

Oro Hondo Developments are understood to have been back of the recent purchase of the Montezuma and Whizzers, near Deadwood. John T. Milliken, who has for two years been developing Oro Hondo in search of the southerly extension of Homestake orebodies, has now secured control of the property adjoining Homestake on the east, extending to the city limits of Deadwood, and covering over 1 mi. of outcrop of the big "iron dike," one of the strongest and most persistent veins in the Black Hills. Encouraging developments in Oro Hondo are believed to be responsible for the move, though information regarding underground conditions is kept confidential. The Oro Hondo shaft is 2000 ft. deep, and four diamond drills were used during the greater part of 1916 in exploratory work.

MORENCI, ARIZ.—Jan. 19

Mine Fires in the Morenci District are engaging the serious attention of the operating officials. The Detroit Copper Mining Co. and the Arizona Copper Co. have jointly offered a reward of $500 for the arrest and conviction of the vandal who set fire to the Copper Mountain mine belonging to the former company and the Clay mine belonging to the latter on or about Sept. 23, 1916. Although all effort practicable has been made and expense unspared in an endeavor to extinguish the fires, they are still burning, and, in the case of the Copper Mountain fire, the work of combating and the threatening attitude of the conflagration are daily becoming more serious. The old stope that is burning in the Copper Mountain adjoins a big square-set stope of the Arizona Copper; this is in turn connected with the immense and much timbered old and current workings of the latter company; if the fire ever crosses into

this area, many of the mines will be closed. To prevent this, all the lower levels of the Copper Mountain have been flooded, and, just as soon as the Arizona Copper Co. shall have finished bulkheading off its workings, the water will be raised to higher levels. But this will take time and lots of water, as the country is open and the water gets away at a fast rate. The miscreant who fired the Copper Mountain mine was particularly careful to leave no doubt as to his intentions. He climbed up about 200 ft. of ladderways, walked way back in some old workings, did some more climbing and prowling and started his deviltry in a place that not only had been worked out and abandoned months before, but that was extremely dangerous—a place where no man would have gone except to start such a fire. Yet the "hombres" have been heard to remark that they do not want the $500.

HOUGHTON, MICH.—Jan. 22

The Weather and Production are intimately associated at this period of the year. The output of the copper mines in the Lake Superior country for the next two months will be largely dependent on weather conditions. Ore traffic has not as yet been interfered with to any great extent, but plows, etc., have been kept at work in the numerous cuts. More men, attracted by the high wages paid in the district, are coming in daily, thereby helping the smaller and more remote mines to maintain their outputs despite the more severe weather conditions.

BRAINERD, Minn.—Jan. 18

Tax-Case Decision on Jan. 9 favored the Cuyuna Range operators. This is the first round in their legal fight against the high taxation of undeveloped mineral lands. District Judge W. S. McClenaghan held that the state tax commission's figures were exorbitant and unreasonable, and in his opinion the theory of the tax commission in assessing prospects on the same basis as actual mines was erroneous and illegal. This case is the outcome of a protest entered by George H. Crosby of Duluth, against the high assessed valuation placed on Lot 1, Sec. 18,46-29, Crow Wing Co., Minn. The assessed valuation in 1913 was $110. During this year exploration work was conducted and a low-grade orebody developed. In 1914 the tax commission placed the assessed valuation at $44,000. In 1915 it was $35,000 and $93,000 for 1916. The court held this as exorbitant and unreasonable and ordered the assessment reduced to $2500. The case has been appealed and if the state supreme court affirms this decision, it will not only mean a great reduction in taxes, but a thorough exploration of the Cuyuna Range. Heretofore mining men have been reluctant to explore mineral lands because of the high taxes that must be paid each year when an orebody has been indicated and for this reason only enough exploration work is done to assure the operator of a sufficient tonnage to warrant mining.

JOPLIN, MO.—Jan. 20

New Record for Milling in this district was made by the Netta mill of the Eagle-Picher Lead Co., at Picher, Okla., last week. In 20 hours' continuous operation, the plant made 107 tons of zinc concentrates and 6 tons of lead. Previous record was about 65 tons. The Netta mill had the advantage of unusually good ore, only about 1400 tons being used in this run. The mill is the largest of the Picher group and was completed last summer. It is electrically operated throughout. A. E. Bendelari, of Joplin, is general manager of this and of other of the company's mills.

Drill Strikes of Exceptional Richness are being reported from the Oklahoma section of the field. An assayer's report on a recent hole put down on the R. F. Hartley farm, south of Baxter Springs, Kan., showed 20.5% blende from 195 to 200 ft.; 31.8% blende at 205 ft.; 39.95% at 210 ft.; 43.05% at 212 ft.; 17.07% at 215 ft.; 32.1% at 217 ft.; and 4.80% at 218 ft. A still richer hole than this is reported by the Walker Mining Co., on a lease near the Oklahoma-Kansas state line. The drill encountered ore at 170 ft.; for 23 ft. the average assay was 45% blende, and for the next 47 ft. it was slightly better than 20 per cent.

WASHINGTON, D. C.—Jan. 23

Oatman Geologic Work cannot be undertaken this winter, due to the fact that topographical maps cannot be completed in time. Adolph Knopf, who was preparing to direct the geological work at Oatman will consequently proceed immediately to the Rochester district of Nevada to make a geological study of that mining region. This probably means the deferring of the Oatman work until fall.

Transfer of Bureau of Mines to the Department of Labor has been proposed by Secretary Wilson and submitted to Congress. In addition the Secretary of Labor suggests that all, or a portion, of the work being done by the following bureaus of other departments be incorporated in the Department of Labor: Public Health Service, Office of Markets and Rural Organization, Steamboat Inspection Service, Bureau of Navigation, Interstate Commerce Commission and the Board of Mediation and Conciliation. Several previous attempts have been made to incorporate the Bureau of Mines in the Department of Labor but each of these has failed. That the effort is to be renewed, and this time with all the stimulus that is given legislation by a direct recommendation by an officer of the cabinet, is generally recognized. Such a movement, if successful, would make impossible the continuance of the Bureau's coöperation with mine operators and with manufacturers, many here believe. Much of the success of the work of the Bureau of Mines has been due to the cordial coöperation of those representing the capital employed in mining operations. Representatives of the Bureau of Mines, who are in constant touch with mine operators, have sounded the sentiment among operators in regard to the transfer of the Bureau to the Department of Labor. The consensus of opinion thus obtained indicates that the same measure of coöperation would not be extended the Bureau if the change should be made. This is not due, those reporting say, to any hostility to the Department of Labor. It simply is recognized that the act establishing the Department makes it first and above all the representative of the employees. The Secretary of Labor describes his department as "labor's State Department." While many employers are under the impression that the Department of Labor goes to the extent of seeking special privileges for organized labor; even if it were proved to them that this was not the case they would hardly be willing to disclose their records and secrets to a bureau of a department, the duties of which are prescribed by law as being "to foster, promote and develop the welfare of the wage earners of the United States," especially when the organic act makes no mention of any obligation to the employers of labor. In view of the well-known sentiment existing among employers, efforts already are being made by friends of the Bureau of Mines to meet any activity on the part of the Secretary of Labor to secure this legislation.

TORONTO—Jan. 20

New Gold Field in Powell Township, to the northwest of Elk Lake, is attracting many prospectors. The first find was made in November by a prospector named Davidson, free gold being discovered in a vein reported to be very wide. Since then discovery has been confirmed and many good samples of gold have been shown. About 75 claims have been staked and prospectors are busy in Powell and the adjoining townships despite unfavorable weather. A rush is anticipated in the spring.

The Mining News

ALASKA

KENNECOTT (Kennecott)—Kennecott Copper Corporation's Alaskan properties produced 111,536,000 lb. of copper in 1916; its total copper production, including Braden's 44,671,000 lb., was 156,207,000 lb. The Alaskan mines in 1915 produced about 63,000,000 lb., and Braden 35,444,000 lb.

ALASKA MEXICAN (Treadwell)—Mill ran 18 days 6½ hr. in November, crushing 12,075 tons yielding $15,873 or $1.33 per ton; operating expense, $14,769; operating profit, $1104; construction, $5698; loss, $4594; miscellaneous income, $3783.

ALASKA TREADWELL (Treadwell)—In the 300-stamp mill, 150 were operated in November crushing 25,627 tons yielding $57,860 or $2.28 per ton; operating expense, $31,405; operating profit, $26,454; construction, $17,711; net operating income, $8743; other income, $11,762; total net profit, $20,506. Stock of broken ore decreased 14,226 tons.

ALASKA UNITED (Treadwell)—Crushed in November in Ready Bullion mill 22,610 tons and in 700-Ft. Claim mill 20,030 tons yielding respectively $40,844 and $45,455 or $1.82 and $2.29 per ton. Ready Bullion operating expenses, $40,823; operating profit, $21; construction expenses, $28,935; loss, $28,913; miscellaneous income, $1940. The 700-Ft. Claim operating expenses were $68,492; operating loss, $23,036; construction expenses, $9038; loss, $32,075; miscellaneous income $1940.

ARIZONA

Cochise County

BLACK PRINCE (Johnson)—Has resumed after shutdown, owing to coal shortage.

CALUMET & ARIZONA (Bisbee)—High-grade sulphide ore reported in Pay Day claims, 2000 ft. southeast of Junction shaft.

ARIZONA-DRAGOON COPPER CO. (Pearce)—Has bonded five claims 10 mi. west of town. Four hundred tons of copper-silver ore on dump is being transported to Pearce on burros.

HELENS DOME MINING (Bowie)—New corporation composed of Bowie men; T. J. Quillin, president. Will develop 18 claims, 14 mi. south of Bowie.

BISBEE COPPER MINING AND DEVELOPMENT (Bisbee)—Reports encountering copper sulphides at depth of 610 ft. in drill hole on Pauline claim.

FLOSSIE MINING CO. (Johnson)—Controlled by local business men; four claims owned; shaft down 100 ft.; one car running 8% copper and one running 12% shipped recently. At present 7 ft. of the shaft is in 10% ore; contract let for drifting on 100-ft. level. L. W. Rader, secretary; Asa Walker, superintendent.

Gila County

IRON CAP (Copper Hill)—Ore struck at 35 ft. from shaft on 900 level.

VAN DYKE COPPER (Miami)—Now exploring with large rotary drill.

INSPIRATION (Miami)—Stoping on highest slice completed and cap allowed to cave; mill recently treating about 17,000 tons daily.

GREAT RAY COPPER (Ray)—New organization to develop 800 acres in vicinity of Ray Consolidated. Superintendent, F. A. Richards.

INTERNATIONAL SMELTING (Miami)—Structural steel shipped from Kansas City for new addition, which will cover three waste-heat boilers, one new reverberatory, and four additional drying furnaces. Copper output now reported to be 18,000,000 lb. per month.

Graham County

ARIZONA COPPER (Clifton)—December output 2230 tons.

Mohave County

GOLD ROAD (Goldroad)—Cut 11 ft. of milling ore in northern part of property, hitherto unprospected; second crosscut being driven.

MOSS (Oatman)—Being prospected by diamond drill by Venture Corporation Ltd., of London. First drill hole, down 500 ft. on 60° angle, has cut ore; second hole started.

UNITED EASTERN (Oatman)—Opened shoot of high-grade gold ore, assaying up to $4000 per ton.

Maricopa County

SLOCUM (Glendale)—Taken over by Jerome Butte Copper Co.; ore carries some gold and silver besides copper.

CONSTANTINOPLE (Wickenburg)—This property, 12 mi. south of Wickenburg, sold to O. D. Warnock and associates of El Paso; ore carries gold, silver, lead and copper.

Santa Cruz County

MOWRY (Mowry)—William J. Mitchell, manager for Standard Metals Co., plans to reöpen old Mowry mine soon.

BROCKMAN & CO. (Nogales)—Erecting 100-ton flotation mill to treat custom ores and also ore from their El Pilar mine in Santa Cruz Mountains, 28 mi. from Nogales.

MONTANA MINES CO. (Ruby)—Machinery arriving for 200-ton flotation mill; shaft being sunk to 700-ft. point; 15-ft. orebody opened; completion of road to Nogales, now under construction, will reduce distance from 70 to 30 mi.

Yavapai County

ALGONKIAN (Crown King)—High-grade gold ore reported on lowest level.

SHANNON COPPER (Clifton)—Has leased Yeager copper mine between Jerome and Prescott in Black Hills district. Unwatering to prospect lower levels.

LITTLE JESSIE (Chaparal)—Plans for reduction plant accepted; three shifts working; will develop to 600-ft. level and treat old dump.

WILDFLOWER (Crown King)—Tramway being built to new mill of Bradshaw Development Co. at Crown King; crosses Del Pasco peak at elevation of 8000 ft.; will serve to carry ores from the Montezuma, Old Reliable, Del Pascos, War-Eagle-Gladiator, Nelson and other properties.

CALIFORNIA

Amador County

HARDENBERG (Jackson)—Old workings cleared of water and deepening of shaft started. W. J. Loring, general manager.

CENTRAL EUREKA (Sutter Creek)—Shaft 150 ft. below the 3200 level. Body of high-grade ore reported; extent of this ore will determine whether sinking will be continued. Fred Jost, superintendent.

CONSOLIDATED AMADOR (Sutter Creek)—Shaft retimbered to 1400-ft. point and installation of pump in progress. Fire which was said by early operators to have caused closing of mine was apparently not of particularly serious nature; no charred timbers of consequence encountered except at the 800 level. After completion of pump installation, surface installations will be pushed.

Butte County

HEDGE (Oroville)—New 5-stamp mill in commission. Ore opened for 130 ft.

Inyo County

CALIFORNIA TALC CO. (Keeler)—Installing 20-ton mill for grinding talc; property between Keeler and Darwin. Raw material will also be shipped. J. K. Stewart, San Francisco, is president; J. W. R. Stewart, manager.

Nevada County

UNION HILL (Grass Valley)—Contemplate deepening shaft and prospecting lower ground. New claims added to group. Erroll McBoyle, manager. Reopening of the South Idaho contemplated.

CHAMPION (Nevada City)—Ore improving as depth is attained. Ten additional stamps now dropping, making a total of 40. This is the only large mine operating in the Nevada City district. Since its purchase by the North Star Mines Co. a large amount of money has been spent in development and equipment. The mine promises to be a large producer of medium-grade ore.

Placer County

DREDGING GROUND on north fork of American River prospected by the Guggenheim interests reported satisfactory and dredge to be installed within the year. Probable that the dredge which has worked out its ground on middle fork of American River will be dismantled and the machinery removed to this ground in the vicinity of Applegate, where a new steel hull will be constructed. The dredging ground is situated north of Auburn and extends for a long distance up the river. H. C. Perring, who had charge of construction of middle-fork dredge and the recent construction on the Yuba River, will superintend the work.

Plumas County

COPPER MOUNTAIN-SUMMIT (Indian Falls)—This group of 36 claims optioned to H. L. Huston of San Francisco.

PILOT (Indian Falls)—Goodhue Bros. who purchased this mine two months ago driving tunnel to cut vein 300 ft. below upper workings. Recently shipped 10 tons gold-copper ore on which smelter returns were over $1200. About 50 tons high-grade milling ore on dump.

INTERNATIONAL SMELTING (Portola)—Haul from Walker mine to Portola, 26 mi., shortened by extension of railway to Indian Valley. Company has optioned the Tutt and Green Ledge mines.

U. S. SMELTING, REFINING AND MINING EXPLORATION CO. (Genesee)—This Boston company has option on Genesee, Italia, Providence, Five Bears, Calnan group, Eagle Hill group and Cliff mines near Genesee and the Iron Dike at Taylorsville. From 3300 ft. in Five Bears tunnel, a 40-ft. crosscut has uncovered chalcopyrite orebody; larger compressor to be installed. Genesee to be prospected at 200 level before sinking is resumed. Gold-copper ore opened in Calnan group and Eagle Hill mine being developed by tunnel. Air compressor installed at the Iron Dike to aid in driving tunnel.

Shasta County

DONKEY (Ingot)—Reported that this copper property adjoining the Afterthought will be reopened and developed by the Mammoth company. Situated in the Little Cow Creek region about 10 mi. southeast of Bully Hill copper-zinc mines and about 25 mi. northeast of Redding. Reported that the Afterthought will also be reopened.

Sierra County

ON SLATE CREEK, near Howland Flat, a large restraining dam recently completed. In spring, hydraulicking will be done here and at St. Louis, by Los Angeles operators.

SIERRA MINING CORPORATION (Sierra City)—Organized by John V. Powers to develop Shamrock group of 10 claims. Work begun; crew to be augmented in spring.

SIXTEEN-TO-ONE (Alleghany)—In apex suit against Twenty-One Mining Co., motion of defendant to dissolve injunction against mining on disputed vein, denied and plaintiff ordered to suspend operations and furnish bond of $30,000 to insure compliance.

Siskiyou County

BLUE NOSE PLACER (Somesbar)—Permitted to issue 15,000 shares each to Donald MacPherson, L. D. Graeter, H. C. Nelson, 7500 shares to Lee Harris, and 2750 shares each to Emil Franks and L. D. Hinds in payment for five placer claims aggregating about 100 acres situated on Klamath River, 25 mi. north of Somesbar. Also permitted to sell 19,995 shares for development.

Tuolumne County

SPRINGFIELD TUNNEL (Columbia)—Rich gravel disclosed in old Fox channel near the Davis ranch, on both rims; center of channel will be prospected.

BLACK OAK (Soulsbyville)—Diamond drilling totaling 1800 ft. completed. Drill removed to Dutch mine near Jamestown where exploration of new ground will be started.

RAWHIDE NO. 2 (Jamestown)—Purchase option secured from the Hobart estate by H. H. Stambaugh and R. C. Steese, of Youngstown, Ohio. It is stated that development will be started immediately.

CHILANO (Tuttletown)—High-grade ore encountered on 160-ft. level; vein 12 ft. wide. Will raise to 75-ft. level when new compressor is installed. Bonded to International Mines Co., 4 Post Office Square, Boston.

Yuba County

YUBA NO. 8 DREDGE (Hammonton)—W. Chromas, an oiler, was caught in tailing belt at upper end of stacker and fatally injured Jan. 17.

COLORADO

Dolores County

RICO MINING CO. (Rico)—Pro Patria tunnel being retimbered, preparatory to opening more of the mine to leasers; several leasers now at work. George E. Hicks, superintendent.

ARGONAUT (Rico)—Trial shipment being prepared from strike lately made at this property near southern limits of city. Bert Arms, owner.

Gunnison County

BUFFALO HEAD (Pitkin)—Another strike of silver ore made by A. L. Pearson in this property south of Bald Mountain.

Clear Creek County

CAPITAL (Georgetown)—Another strike of "picture rock" in this mine has greatly stimulated prospecting in Georgetown district.

Ouray County

VERNON (Ironton)—Sampling of oreshoot recently crosscut on 100-ft. level showed 4 ft. of extremely high-grade silver-copper smelting ore and 10 to 15 ft. of good-grade milling ore, some of which may be smelted when transport conditions are normal. Shaft now 300 ft. deep; after crosscutting to oreshoot on this level, will be sunk to 500 ft.

San Miguel County

COLORADO-SUPERIOR (Telluride)—This company, owning the Black Bear mine, milled in its fiscal year ended Sept. 30, 1916, 48,450 tons yielding 3506 oz. of gold bullion, 1888 tons of lead concentrate and 4660 tons of zinc concentrate. Net operating profit, $67,660. Operating costs, including development and new construction, was $3.956 per ton milled. Isaac Nevala, superintendent.

KENTUCKY

KENTUCKY ROCK ASPHALT CO. (Asphalt)—Over 40,000 acres in Edmonson and adjoining counties, owned by the Bee Spring and the Wadsworth companies, taken over by this new company of Pittsburgh men.

MICHIGAN

Copper

ISLE ROYALE (Houghton)—Shipping 3200 tons daily to mills. The track is laid in No. 7 shaft and three new drifts are being opened southward.

QUINCY (Hancock)—Sending about 4500 tons daily to mill from three shafts. Much ore coming from below the 60th level. Mass copper encountered at 70th level last year, has now been removed; was one of largest copper masses ever found in district.

NEW ARCADIAN (Houghton)—On 1500-ft. (bottom) level crosscut will be continued farther to identify positively lode thought to be the New Arcadian.

AHMEEK (Ahmeek)—Has received equipment for eighth head for mill at Hubbell; expect it to be in operation in from four to five weeks. Seven stamps now in commission operating to full capacity. When eighth head is ready La Salle's 500 tons per day, which is now treated at the Franklin mill, in all probability will be sent to the Ahmeek.

CALUMET & HECLA (Calumet)—Copper proper production from C. & H. and subsidiaries was as follows in December (year's output given in parantheses): Calumet & Hecla, 6,424,053 lb. (76,762,240); Ahmeek, 2,321,536 (24,142,158); Allouez, 770,223 (10,219,290); Centennial, 193,050 (2,367,400); Isle Royale, 1,113,814 (12,412,111); La Salle, 169,211 (1,380,352); Osceola, 1,561,836 (19,586,501); Superior, 254,477 (3,034,656); Tamarack, 582,267 (6,618,507); White Pine, 238,307 (4,207,449).

MINNESOTA

Cuyuna Range

MANGAN NO. 1 (Ironton)—Shaft sinking completed from 105 ft. to the 155-ft. level which will be the main level.

FERRO (Ironton)—Hoisting 160 tons daily; produces best grade of manganiferous ore on the range. Average of stockpile, 25% Fe, 0.085 P, 25.34 Mn, 17.02 SiO_2 and 11% moisture.

Mesabi Range

FRANTZ (Buhl)—This mine, idle since 1905, being opened by M. A. Hanna Co. Shaft being unwatered and surface equipment being improved.

LA RUE (Nashwauk)—"Scramming" operations around pit will soon start. Improvements in progress at washing plant; turbine being installed; 380,000 tons handled in 1916.

MACE (Hibbing)—No. 1 mine shipped in 1916 to Great Northern docks at Superior, Wis., 157,251 tons; to Zenith Furnace Co., Duluth, Minn. (all rail), 6100 tons; total, 163,351 tons. No. 2 mine shipped 367,443 tons to Great Northern docks. Oscar B. Warren, general manager.

MISSABE MOUNTAIN (Virginia)—Being opened on large scale by Oliver Iron Mining Co. Four steam shovels now in use, two of which are cutting approaches. Company has purchased three large 315-ton Bucyrus shovels; these are of revolving type with 87-ft. boom; one will be at Virginia, another at Eveleth and the third at Hibbing. Five such shovels will operate on the range during coming year.

MISSOURI

Joplin District

WALKER (Miami, Okla.)—Drill hole on Wright land, north of Tar River, Okla., showed better than 45% blende for 23 ft. and 20% for next 47 ft.

MONTREAL (Tar River, Okla.)—Broke into underground cavern at mine at Century, Okla., containing chunks of galena and blende, some weighing 5 tons.

DEFENDER (Commerce, Okla.)—Sold to Taylor & Funkhouser, of Roanoke, Va. Shaft now down to ore and mill is to be erected.

WAYLAND (Galena, Kan.)—Water line put in from creek. Six-inch centrifugal pump used for 110-ft. lift from creek to mill.

BERTA LEE (Joplin)—Good strike in new shaft on Myrick land, on West Twentieth St. A 14-ft. face of ore opened at 110 ft. Mine near old Pumpkinhead. Hand-jig plant used at present.

AURORA CONSOLIDATED (Aurora)—Planning second shaft known as Sassafras, so as to keep mill busy double shift.

TRENTON (Commerce, Okla.)—Struck 10-ft. face of galena in lease, 3 mi. west of Commerce in new territory.

PIOKEE (Quapaw, Okla.)—New 300-ton mill almost ready to operate. A 30-ft. face of ore proved. Owned by Church & Winger.

NIANGUA (Commerce, Okla.)—Paid $30,000 for Thomas-Smith-Wells lease north of town. E. S. Warner, Buffalo, Mo., president.

MISSOURI MINING (Joplin)—New 150-ton mill operating on old Frisco land, at Thoms Station.

MONTANA

Fergus County

JUDITH MOUNTAIN GOLD MINING (Giltedge)—Company recently incorporated by J. L. Bruce and others, of Butte, to develop the Mammoth group. Controls 55 acres of patented claims and 40 acres unpatented, and a 50-ton cyanide plant. Large low-grade gold orebody to be explored as well as some narrow high-grade seams. About 600 ft. from old Gilt Edge mine. Mill will be started if development proves satisfactory.

Lewis and Clark County

BARNES KING DEVELOPMENT (Butte)—December bullion amounted to $74,395. At Piegan-Gloster mill 5388 tons were treated, 3093 coming from Shannon mine. Shannon ore averaged $14.39 per ton and Piegan-Gloster ore $7.83. North Moccasin properties near Kendall in Fergus County, produced 2806 tons yielding $15,728 or $5.60 per ton.

Silver Bow County

ANACONDA (Butte)—All company's Butte mines closed on Jan. 22 owing to coal shortage at Washoe Reduction Works. St. Lawrence shaft will remain closed for retimbering.

BULLWHACKER MINING CO. (Butte)—Negotiations are under way for transfer of control of the Butte-Bullwhacker mine from East Side Leasing Co. which has an option at 50c. per share, to the leasers of the Butte-Duluth company which includes Samuel Newhouse, Mr. Bamberger, Alfred Frank and other Salt Lake mining men. Transfer to be made at rate of 75c. a share. I. H. Heilbronner is president and Patrick Wall manager of the East Side company. Decision to transfer property reached because of high cost of treating Bullwhacker ore, which is now being shipped to Salt Lake, Tacoma and Granby, B. C. By the transfer of control, the ore will be treated in the Butte-Duluth plant, thus eliminating a large percentage of the transportation costs. Old Shaft on Bullwhacker is down 400 ft.; the new shaft is 100 ft. deep. Most of ore shipped recently was extracted from the gloryhole.

NEVADA

Esmeralda County

REORGANIZED KEWANAS (Goldfield)—Driving west crosscut from raise, from 840-ft. level to intersect oreshoot that showed about 4 ft. of $40 ore near that level.

SPEARHEAD (Goldfield)—Sinking suspended for lateral development of latite-shale contact from station recently cut at depth of 910 ft.

Humboldt County

ST. ANTHONY MINES CO. (Toy, via Lovelocks)—Announced that mine and 50-ton mill will be closed for present; about 30 men were employed at mine and mill. Other properties of company producing.

Lincoln County

GROOM (Indian Springs, via Las Vegas)—Producing 60 tons per week of high-grade lead-silver ore; hauled by tractors and trucks about 50 mi. to Indian Springs station.

UVADA COPPER (Pioche)—Shipping about 30 cars of ore per month. Stated that examination is under way, with view to purchase by Salt Lake City men.

Lyon County

BLUESTONE (Mason)—Has begun shipments to Mason Valley Mines Co. smeltery at Thompson.

NEVADA-DOUGLAS (Ludwig)—Over 300 men now employed by this company.

Nye County

TONOPAH ORE PRODUCTION for week ended Jan. 13 was 9396 tons valued at $169,985, compared with 7461 tons for week previous. Producers were: Tonopah Belmont, 3002 tons; Tonopah Extension, 2380; Tonopah Mining, 1650; Jim Butler, 1050; West End, 885; Halifax, 211; Rescue-Eula, 192; miscellaneous, 26 tons.

NORTH STAR (Tonopah)—On 1050-ft. level in northerly crosscut off main east crosscut, management reports cutting 2-ft. vein of milling ore.

TONOPAH BELMONT (Tonopah)—Report for quarter ended Nov. 30 shows receipts from bullion, etc., to be $641,591; operating expenses, $342,216; miscellaneous income, $8964; net income, $308,340.

TONOPAH EXTENSION (Tonopah) — Additional pumps placed for unwatering of Victor shaft below 1540-ft. level. Shaft flooded to this level as a result of the interruption to electric-power service during Christmas week.

JIM BUTLER (Tonopah)—For year ended Sept. 30, 1916; total production was $919,604 from 46,489 dry tons or $19.78 per ton; total net realization was $359,386.82 or $7.73 per ton. There was 10,428 ft. of development done at $7.58 per ft. At end of period; ore reserves were 19,158 tons; cash in bank, $267,724; silver stored, 194,991 oz.

TONOPAH MINING (Tonopah)—Has secured extension of option on Mizpah Extension and will continue development as during last two years. For quarter ended Nov. 30, net realization, $399,463; operating expenses, $220,346; net earnings, $179,117, and miscellaneous income, $142,455; exploration expense, $13,113; net income for quarter, $308,459. Quick assets, $1,593,812, including silver bullion stored, $430,011.

Storey County

OPHIR (Virginia)—South drift 2700 level advanced to 91-ft. point; face in quartz and porphyry.

ANDES (Virginia)—Sawed 80 cars of ore from stope on 350 level, averaging $8.90.

COMBINATION SHAFT (Virginia)—Headframe completed; electrical connections being made; compressor being repaired.

CONFIDENCE-CHALLENGE-IMPERIAL (Virginia)—East crosscut in porphyry. West crosscut to be started soon.

JACKET (Gold Hill)—Two shifts working at tunnel, cleaning out and making repairs; 21 cars ore saved; cyanide plant in operation; bar of bullion shipped.

White Pine County

NEVADA CONSOLIDATED (McGill)—Reduction capacity now about 12,000 tons but is temporarily much reduced owing to coal shortage.

NEW MEXICO

Grant County

CARLISLE (Steeplerock)—New Hardinge 6x32 ball mill received. Ore is crushed to 1¼ in.; fed to Hardinge mill; passed to spitzkasten, from which slimes go to flotation machines, sands dropping to Wilfley tables.

SOUTH DAKOTA

Black Hills District

CUSTER PEAK (Nahant)—Shaft is 300 ft. deep. Crosscut will be driven 350 ft. to catch vein.

NEW PURITAN (Deadwood)—Development continues, with satisfactory showings. Ore is being blocked out, and it is probable mill will be put in operation in spring.

DEADWOOD - HEIDELBERG (Deadwood) — Crosscut being extended to surface for ventilation and to give easy means of delivery of ore from new vein. Shipments to Golden Reward mill are planned as soon as connection is made and bins installed.

MINNESOTA (Maitland)—Development for purpose of locating downward extension of Unionville outcrop, is under way. Crosscuts being driven easterly and westerly from adit tunnel.

UTAH

Beaver County

LEONORA (Milford)—Two feet of ore, carrying copper, lead, and silver, recently opened. A. C. Nebeker, superintendent.

PALOMA (Milford)—Carbonate lead-silver ore on 700 level has widened from 1 to 5 ft. in thickness.

CREOLE (Milford)—Copper-silver-gold ore reported to have been opened in 12 places on this property. Eighteen teams hauling. About 20 miners working.

BEAVER COPPER (Milford)—Crosscutting being done on 200-ft. level for oreshoot developed on level above. Expected to reach the vein in about 30 ft. L. Merriman, superintendent of the Yankee at Tintic, manager.

PALOMA (Milford)—Three feet of galena ore cut on 600-ft. level. Two feet of copper ore opened on 700. Inclined shaft being sunk; should reach 800-ft. point by end of January. C. J. Graff, superintendent.

MONITOR (Milford)—About 20 cars or 900 tons of ore shipped since Nov. 10. Property adjoins Moscow on southeast. Recently leased to P. Kimball and A. F. McCulley. Ore from stope near tunnel level carries gold, silver and lead. Owned by E. H. Althoff.

Iron County

ARROWHEAD (Lund)—Mines Development Co. has made another shipment of lead-silver ore from this property.

Juab County

TINTIC SHIPMENTS for week ended Jan. 12 amounted to 210 cars, 23 properties shipping.

LOWER MAMMOTH (Mammoth)—Control recently acquired by Knight interests.

IRON BLOSSOM (Silver City)—Operations curtailed owing to recent accident to hoisting equipment.

COLORADO (Silver City)—Shaft being sunk under contract nearing 1700-ft. level. Good progress being made. To be carried to greater depth before prospecting is undertaken.

GOLD CHAIN (Mammoth)—Operations resumed Jan. 4 after shutdown of about a week. Trouble caused by freezing of air line from the Grand Central, which furnishes power to Gold Chain.

GEMINI (Eureka)—Arrangements made to increase shipments from 2000 tons to 3000 tons per month. Output for 1916 approximately 25,000 tons. High-grade silver-lead ore opened to and below water level, in a number of places on 1800.

TINTIC MILLING (Silver City)—Mill resumed operation Jan. 7, after shutdown caused by failure to obtain regular shipments of salt. Some inconvenience owing to frozen ores.

DRAGON CONSOLIDATED (Silver City)—Shaft in northern end of property down 400 ft. below tunnel level, corresponding to 900 in Iron Blossom; will be continued another 100 ft. before starting development. Best ore comes from northern end, and is extending to greater depth.

EUREKA MINES (Eureka)—Development being done by company from 900 and 1300 levels of Gemini, to cut several ore-bearing fissures productive in latter property. Owns 47 acres of patented ground adjoining Gemini, Eureka Hill, Eagle & Blue Bell, and Chief Consolidated. W. R. Wallace, president; Jackson McChrystal, manager.

Salt Lake County

ALBION (Alta)—Two faces of ore opened by lessees working in Quincy tunnel. These are on the Kate Hayes and Connor fissures.

SOUTH HECLA (Alta)—Ten cars of ore shipped week ended Jan. 14. Many teams hauling. Roads in good condition for bobsleds. Altogether 35 to 40 outfits hauling from camp.

SILVER SHIELD (Bingham)—Two feet of galena ore opened in drift near main stope; 25 mine cars extracted. Shipment of gold-silver-copper ore made by Bassett lease.

UTAH CONSOLIDATED (Bingham)—Working forces reduced on account of difficulty in securing coal and coke. Some curtailment in development. Mining being carried on.

Summit County

PARK CITY SHIPMENTS for week ended Jan. 12 amounted to 3,527,670 lb., by seven shippers.

NAILDRIVER (Park City)—Fifty-ton shipment made week ended Jan. 12 by J. D. Fisher, lessee. Ore showing continues good.

CALIFORNIA-COMSTOCK (Park City)—Lessees carrying on development and mining at this property in Thaynes Cañon.

IOWA COPPER (Park City)—Road broken to this property near Scott Hill, and 100 tons of ore being hauled. Compressor, motor, and other machinery shipped, and will be hauled to property at once.

ONTARIO (Park City)—Retimbering of shaft progressing and will soon be completed as far as 600 level. Lessees mining and marketing ore from below 600.

Utah County

NEW RAILWAY INTO DEEP CREEK is within 5 mi. of Goodwin, the proposed terminus, and is expected to be completed by Feb. 1.

BUFFALO CONSOLIDATED (Ophir)—Ore recently opened varies from a few inches to 2 ft., and runs well in silver, lead, and gold; 100 tons accumulated awaiting shipments. Property on Lion Hill. A. W. McClelland, manager.

WESTERN UTAH COPPER (Gold Hill)—Further ore being blocked out at this property. New crosscut in ore of shipping grade for 76 ft. Expected to start shipments over new railroad about Feb. 1. Duncan MacVichie, general manager.

COPPEROPOLIS (Gold Hill)—Shipments to be started from this property on completion of railroad. Ore being mined and stored on dump. Recently high-grade copper ore drifted on in vein for 28 ft. Owned by Dunyon and Bamberger interests.

POLE STAR COPPER (Gold Hill)—First shipment of ore over new Deep Creek railway made from this property. Ore hauled 15 mi. by auto-truck to siding at Erickson's Ranch. Shipments to be continued. Pole Star claims, located by F. A. Hudson 25 years ago, recently acquired by Pittsburgh interests. Up to 6 ft. of partly oxidized ore carrying limonite and chalcopyrite opened. Ten men working; hoist and other equipment ordered.

CANADA

Ontario

ADANAC (Cobalt)—Crosscutting started at 400-ft. level; expect to cut three veins within 150 ft.

LA BELLE KIRKLAND (Kirkland Lake)—Main vein cut by drilling at depth of approximately 650 ft. Two parallel veins encountered.

KNAPP, HENDRICKSON & MORTONSON (Tashota)—Have shaft down 20 ft. on 8-ft. vein; free gold visible.

ASSOCIATED GOLDFIELDS (Larder Lake)—Nine carloads machinery and supplies have forwarded to this property.

PITTSBURGH LORRAINE (South Lorraine)—Vein, carrying some high-grade, developed on 300-ft. level.

DAVIDSON (Porcupine)—It is stated that main vein on 300-ft. level has widened to 97 ft., being the largest in the camp at depth, excepting the Dome.

PORCUPINE PREMIER (Porcupine)—Has installed two 60-hp. boilers and six-drill compressor. Shaft, 100 ft. deep, will be continued to the 300-ft. level.

HURD CLAIMS (Kirkland Lake)—Being developed by La Rose Consolidated of Cobalt. Main vein widening at a depth of 25 ft. A second vein discovered 40 ft. from main vein.

TASH ORN MINING (Tashota)—Down 80 ft. with 9x12-ft. shaft; vein showing free gold has widened to 7½ ft. Compressor and steam hoist installed; working 75 men; 40 claims under option. M. Casselburg, Baltimore, Md., president.

Yukon Territory

CANADIAN KLONDYKE MINING CO. (Dawson)—Two of the 17.2-cu.ft. dredges, Nos. 2 and 4, are still operating despite temperatures ranging down to 60° below zero. Gold won in 1916 amounted to about 50,000 oz; the 7½-cu.ft. No. 1 dredge, operating on Hunker Creek, about 25 mi. from Dawson, dug about 4000 cu.yd. daily; the three large dredges, having a capacity of about 12,000 cu.yd., were digging on the "Boyle Concession" in the Klondike Valley, between Dawson and the mouth of Hunker Valley. Work was begun in 1916 on the reservoir dam and ditch to supplement the storage for the Canadian Klondyke Power Co.'s plant on North Fork of Klondike River; will be completed this year. J. W. Boyle, general manager.

SOUTH AFRICA

MODDERFONTEIN B. GOLD MINES, LTD. (Box 1145, Johannesburg, Transvaal)—Directors voted to increase milling capacity to 60,000 tons monthly. Original plant, built in 1911, contained 80 stamps, five tube mills and cyanide adjunct; capacity, 36,000 tons monthly. Capacity increased in 1914 and 1915 to 45,000 tons by addition of 16 Nissen stamps and another tube mill.

JOHANNESBURG CONSOLIDATED INVESTMENT CO. (Johannesburg, Transvaal)—Provisional agreement entered into for purchase of Sir Joseph B. Robinson's holdings in the Randfontein Central, Randfontein Estates and Langlaagte Estate properties. The annual output of the Barnato or "Johnnies" group will then total 9,000,000 oz., and according to the "Financial Times" the profits, estimated at over $14,500,000, will be larger than those of any other single group on the Rand.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

Jan.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Jan.	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
18	4.7581	75⅜	36⅜	22	4.7581	76⅛	37 1/16
19	4.7581	75⅜	36¼	23	4.7581	76⅛	37 1/16
20	4.7581	76⅛	37	24	4.7575	76⅛	37 1/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Jan.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
18	28½ @29½	45½	7.50 @7.60	7.375 @7.500	9¼ @9¼
19	28½ @29½	45½	7.60 @7.70	7.375 @7.500	9¼ @9¼
20	28½ @29½	45½	7.65 @7.75	7.450 @7.650	9¼ @9¼
22	29 @30	45½	7.70 @7.80	7.650 @7.750	9¼ @9¼
23	29 @30½	45¼	7.70 @7.80	7.650 @7.750	9¼ @9¼
24	29½ @30½	45¼	7.70 @7.80	7.650 @7.750	9¼ @9¼

The above quotations are our appraisal of the average of the major market based generally on sales as made and reported by producers and agencies; and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Jan.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
18	....	....	....	....	....	....	....
19	130	126	141	187½	188¾	30½	47
20	....	....	....	....	....	....	....
22	130	126	141	188½	189¼	30½	47
23	130	126	141	191	192	30½	47
24	....	....	....	189¼	190	....	....

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 643c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

NEW YORK—Jan. 24, 1917

Copper and lead were especially strong features last week. Tin was stationary and zinc was reactionary. The aggregate of business in all the metals was relatively small. Transportation difficulties which are locking up large quantities of the metals are recognized as playing increasingly important parts in the markets.

The irregularity in receipt of cables of London quotations, which began last week, continued this week. Cable dispatches were filed as usual, but were held up by the censor, for what reason is unknown here. The mystery is heightened by knowledge that on some days some houses received them, while others did not.

Copper, Tin, Lead and Zinc

Copper—Business was relatively small, but the position of the market was such that the price was bound to advance on any buying demand that was insistent, and such demand there was. Producers booked small orders for second-quarter delivery, but for prompt and February copper buyers had to go to brokers, who might interest some consumers in reselling. There were at least two orders for copper, each for 1000-ton lots, wanted as soon as possible, which had to be directed to brokers. On Jan. 22 buyers were willing to pay 30c. for March copper. Those who must have January or February copper may have to pay 30 to 32c., depending on what they can find. So far as producers know, copper for that early delivery does not exist. Copper for May delivery was sold in several lots of fair size on Jan. 23 at 29½c., r.t. There was some sporadic inquiry on the part of domestic consumers for second-half copper, but speaking generally, there is no interest in that distant delivery. Summarizing, the copper market is substantially in a state of deadlock, and very strong.

Contributory factors in the tightness of copper are troubles at the refineries and freight delays.

At the time of writing the strike at Perth Amboy was still unsettled, but the men were reported to be dribbling in and the worst of the trouble was believed to be over. This strike was for an advance of 5c. per hour in wages and time and a half for overtime. At the Nichols refinery, the large wirebar furnace broke down this week. At Chrome, last week, the blowing engines of the smelting department failed, which deprives the refinery of its full supply of anodes. Other refiners report empty vats, owing to delay by the railways in delivering crude copper from the West.

The delay in railway transportation is the worst ever known. It has been bad for weeks back, but this week troubles were increased by the great snowstorm, Sunday night, in the Northwest, when 20 in. fell at St. Paul. This storm, followed by zero weather, paralyzed traffic.

The freight conditions have not only delayed the transportation of crude copper, but also that of refined copper from the Western refineries.

Copper Sheets—Base price for copper sheets continues unchanged. The quotation is 42c. for hot rolled and 43c. for cold rolled. Wire is quoted on a base of 37c. f.o.b. mill.

Tin—This market was without features of special interest. The price for spot tin was unchanged during the week. Futures opened at 43½c., which price prevailed until Jan. 24, when 43⅜c. was quoted.

Lead—The dominant factors in the lead market this week were the freight congestion and the continuance of the strike at Perth Amboy. Consumers being disappointed in obtaining their expected supplies from the West were obliged to buy locally. When Perth Amboy no longer could ship they were forced to clean up what was in the hands of dealers. A sharp advance in price naturally followed. The great strength of the market is based more-over on the sold-out condition of producers for early deliveries. Producers this week sold for March at the full price. There has been a big inquiry in the market, including some for round lots from abroad.

At this writing, Western refineries are having troubles, especially in obtaining supplies besides which the relative inefficiency of labor continues. At this writing the strike at Perth Amboy appears to be nearing its end, 800 men, which is about one-half the force, being reported at work today.

Spelter—A fair volume of business was reported, including some with galvanizers, which was done at prices receding from day to day. Producers were generally disposed to sell distant deliveries at sharp discounts, but the interest of buyers was mainly in January-March or February-March shipments, few being inclined to commit themselves very far ahead in view of present uncertainties. February spelter is manifestly in liberal supply. January spelter also is probably easier than it looks, there being no doubt that supplies are being held back in some quarters. The idea is still entertained that spelter will have a "come back," but the prolonged absence of European buying is obviously getting on the nerves of producers. There were signs this week of a little more aggression in placing spelter, which was offered in quantities, but the gas troubles in Kansas and Oklahoma, and the freight congestion are still retarding influences against pronounced bearishness.

Zinc Sheets—No change has been made in the market price of zinc sheets. Quotation is $21 per 100 lb., f.o.b. Peru, less 8% discount.

Other Metals

Quicksilver—Firmer and quoted at $80@81.

Antimony—Market strong and higher, with considerable activity at 15½@16½c. February-March shipment from China 12¾@13¼c., c.i.f., New York duty unpaid.

Aluminum—The aluminum market continues quiet with buyers scarce. Nominal quotations are at 59@60c. per lb. for No. 1 ingots, New York.

Magnesium—Pig metal has dropped to $3 per lb. The 80% copper alloy is firm at 2¼c.

Nickel—No change appears in nickel quotations. Price remains at 45@50c. per lb., with electrolytic commanding an additional 5c.

Gold, Silver and Platinum

Gold—There has been no movement of especial note during the week. The situation remains about as last reported. Samuel Montagu & Co., London, report under date of Jan. 4, that the Bank of England gold reserve against its note issue shows an increase of £694,525 as compared with the previous week.

Silver—Market is steady and offerings are absorbed readily. Supplies have been reduced owing to strikes in one of the prominent refineries. Shipments by the Celtic of last week were about 50% of the usual volume.

Mexican dollars at New York were quoted on Jan. 18, 57⅜@60¾; 19, 58½@61½; 22, 59⅜@62⅜; 23, 59¼@62¼; 24, 59@62c.

Platinum—Early in the week sales were made at $88. Since then, the market has become stronger and at the close we quote $88@90.

Zinc and Lead Ore Markets

Platteville, Wis., Jan. 20—Quotations for the district are according to the following figures: Base price per 2000-lb. ton for material assaying 60% zinc is $82.50 for premium ore down to $78 for medium grade. Due to a shortage of high-grade ore, prices are back again and even slightly in excess of the old ratio of 8 to 1 for spelter quotations. Base price per 2000-lb. ton for material assaying 80% lead is $90. Shipments for the week ended Jan. 20 are 2616 tons of zinc ore, 143 tons of lead ore, and 426 tons of sulphur ore. For the year to date the figures are 7745 tons of zinc ore, 317 tons of lead ore, and 1407 tons of sulphur ore. Shipped during the week to separating plants 3360 tons zinc ore.

Joplin, Mo., Jan. 20—Price quotations per 2000 lb.: Blende, high, $87.80; 60% zinc, premium ore, $86; medium, $85@80; low, $78. Calamine per ton 40% zinc, $50. Average selling price, all grades of zinc, $77.57 per ton.

Lead, high price, $91.40, base, $90@88. Average selling price, all grades of lead, $88.32 per ton.

Shipments the week: Blende 8230; calamine, 406; lead, 866 tons. Values, all ores the week, $746,390.

Smelting companies are in sore straits for ore, or they sense a rising metal market, as all the big ones, some that seldom purchase Joplin ore, were in the market and caused prices to advance $11 per ton, with little or no favorable metal change.

Owing to the weaker lead price offerings this week a number of sellers, having disposed of their zinc to advantage, withheld their lead.

Other Ores

Antimony Ore—Supply was scarce. Buyers are reported willing to pay $1.60 and possibly more.

Chrome Ore, lumps, min. 40%, Cr_2O_3 per unit, $1.

Manganese—Demand strong; supply short. Ferromanganese nominal at 8c. per lb. Metallurgical dioxide, 75c. per unit.

Molybdenum Ore—Molybdenite is firm at $1.80, which price was paid, with buyers over at the same price. Ferromolybdenum was strong with buyers at $4, but no sellers for anything like reasonable delivery.

Tungsten Ore—There was an urgent demand for high-grade ore, and especially for scheelite, several hundred tons being contracted at $17.50 for shipment from the West. Wolframite was sold at $17, spot delivery. Stocks of tungsten ore at New York have been greatly reduced and the market has a steady appearance.

Uranium—Samarskite, 13% U_3O_8, nominal at $360 per net ton. Other compounds unchanged. Yellow sodium uranuate, $2.50 per lb.; nitrate, $5; oxide, $3.60.

Other Minerals

(Quoted by Foote Mineral Co. for carload lots. Philadelphia.)

Barytes, 99%, ground, per ton, $18.

Beryl, minimum 12% BeO, per lb., 4c.

Fluorspar, metallurgical, per ton, $28.

Magnesite, raw, per ton, $25. Calcined, per ton, $65.

Tantalite, guaranteed 65% Ta_2O_5, per unit, $15.

Monazite sand, min. 5% ThO_2, per lb. of thorium oxide, $1.90.

Rutile, 24-mesh concentrates, min. 95% TiO_2, per ton, $95.

Ilmenite, min. 50% TiO_2, per ton, $22.50.

Carnotite, 2% U_3O_8, per ton, $130.

Zirkite, metallurgical grade, 80% ZrO_2, per ton, $120.

Cerium-Iron Alloy—Demand is good and firm at $28 per lb.

Iron Trade Review

NEW YORK—Jan. 24

January has developed no signs of a change to easier conditions in the steel trade, says "Iron Age." After all the peace moves, it is apparent that American steel manufacturers will be beset for months with more business, export and domestic, than they can handle. The past week has emphasized the tightening of the situation.

Predictions lately made of a lessened export movement in 1917 are to be taken in the light of larger expectations of an expanding domestic demand which the mills cannot put aside.

Pittsburgh—Jan. 23

Last week's steel shipments of the Carnegie Steel Co. were 15% less than those of the preceding week, which showed close to a normal tonnage. A few mills in the Pittsburgh and valley districts had an even greater curtailment. The chief and growing difficulty is the inability of the railroads to remove cars once they are loaded, scarcity of empties being no longer the greatest obstacle to a free movement. The view is confirmed that the shortage is one of motive power, and little hope of relief is entertained with respect to the Interstate Commerce Commission's efforts to develop quicker return of empty cars.

Steel production has been curtailed somewhat by natural-gas shortage, and this week a flood in the Monongahela River has closed the Edgar Thomson works, together with a few smaller plants. More serious curtailment in production is threatened from the inability to ship steel.

There is no material change in the steel market. Except in the case of shipbuilding material buyers are indisposed to consider the late deliveries, beyond six or eight months. There is insistent demand for earlier deliveries but the mills cannot meet it, and steel promises to be scarcer a month or two hence than it has been thus far. Many manufacturing consumers are now at the point where they must curtail their operations if they do not secure better deliveries. There is no indication that there are stocks of steel in the hands of buyers.

Pig Iron—The Connellsville coke region seems to be shipping only about 75% as much coke as required by the blast furnaces dependent on it. Of the Carnegie Steel Co.'s 59 blast furnaces 12 are inactive, half of these being out of blast and the other half banked. The National Tube Co. has two Lorain furnaces banked. Among independents there are several furnaces banked, but not as great a proportion as in the case of the Steel Corporation, which banks some furnaces and operates others at full capacity. Most of the independent stacks are slowed down. It is surprising that a greater scarcity of pig iron has not developed. The steel mills are drawing upon reserves of scrap and pig iron. Foundries are more actively inquiring for small lots of prompt foundry and malleable iron, and paying premiums up to $2 or $3 a ton for small prompt lots. There continues to be a heavy export demand for bessemer iron but greater difficulty is experienced in securing bottoms. It is possible bessemer is not as strong as it was and of course the abnormal spread of $5 between bessemer and basic, although it has obtained for more than two months, cannot continue indefinitely. We quote: Bessemer, $35; basic, $30@31; foundry and malleable, $30@33; forge, $29@30, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Steel—Sales of billets and sheet bars, even in small lots, are now extremely rare and there is less steel to be found than at any previous time. We quote the market nominally at $60@65, with rods about $75 and forging billets about $80.

Coke

Connellsville—Furnace coke for spot shipment sold at the beginning of last week at $8 and at the close at $9.50, with $10 reported paid in one instance. This week the market is about $9 and is not active. The market demand is not in proportion to the shortage as consumers feel that to pay fancy prices is simply to put the market still higher without increasing the supply. A contract for shipment over the next 90 days has gone through at $8.25. Shipments appear to be about 75% of requirements. There are now considerable stocks of coke in the region.

STOCK QUOTATIONS

N. Y. EXCH.†	Jan. 23
Alaska Gold M.	10
Alaska Juneau	7⅛
Am.Sm.&Ref.,com.	107⅞
Am. Sm. & Ref., pf.	117
Am. Sm. Sec., pf. A	100
Am. Sm. Sec., pf. B.	98
Am. Zinc	37⅛
Am. Zinc, pf.	69⅛
Anaconda	82
Batopilas Min.	1⅛
Bethlehem Steel	430
Bethlehem Steel, pf.	135
Butte & Superior	49
Chile Cop.	25
Chino	54⅛
Colo.Fuel & Iron	46⅛
Crucible Steel	63⅛
Dome Mines	21⅛
Federal M. & S.	11
Federal M. & S., pf.	38⅜
Great Nor., ore ctf.	35⅛
Greene Cananea	44⅛
Homestake	131
Inspiration Con.	57
International Nickel	42⅛
Kennecott	45⅛
Lackawanna Steel	84⅛
Miami Copper	41⅛
Nat'l Lead, com.	60⅜
National Lead, pf.	113⅞
Nev. Consol.	24⅛
Ontario Min.	6⅛
Quicksilver	2
Quicksilver, pf.	2
Ray Con.	26⅞
Republic I.&S.,com.	78⅛
Republic I. & S. pf.	104⅛
Sloss-Sheffield	66⅛
Tennessee C. & C.	15
U. S. Steel, com.	112⅞
U. S. Steel, pf.	120⅛
Utah Copper	105⅛
Va. Iron C. & C.	55

N. Y. CURB†	Jan. 23
Buffalo Mines	1⅛
Butte & N. Y.	1⅛
Butte C. & Z.	11
Caledonia	.57
Can. Cop. Corpn	1⅛
Cashboy	.06
Cerro de Pasco	37
Con. Ariz. Sm	2⅛
Con. Coppermines	3⅛
Con. Nev.-Utah	⅛
Crystal Cop.	1⅛
First Nat. Cop.	3⅛
Florence	.75
Goldfield Con.	.62
Goldfield Merger	.07⅛
Granite	.40
Hecla Min.	8
Howe Sound	7⅛
Jerome Verde	1⅛
Joplin Ore & Spel.	.30
Kerr Lake	4⅛
Magma	49
Majestic	⅛
McKinley-Dar-Sa.	.50
Mother Lode	.43
Nevada Hills	.20
N. Y. & Hond.	15
Nipissing Mines	8⅛
Ore	‡.03⅛
Ray Hercules	4⅛
Rochester Mines	.63
St. Joseph Lead	18
Standard S. L.	.75
Stewart	.21⅛
Success	.37
Tonopah	5⅛
Tonopah Ex.	4⅛
Tribullion	.50
Troy Arizona	.60
United Verde Ext.	37⅛
United Zinc	4⅛
White Knob, pf.	1⅞
White Oaks	3⅛
Yukon Gold	2

SAN FRAN.*	Jan. 23
Alta	.02
Andes	.17
Best & Belcher	.05
Bullion	.02
Caledonia	.25
Challenge Con.	.04
Confidence	.10
Con. Virginia	.07
Gould & Curry	.02
Hale & Norcross	.07
Jacket-Cr. Pt.	.03
Mexican	.07
Occidental	.65
Ophir	.14
Overman	.03
Savage	.07
Seg Belcher	.03
Sierra Nevada	.18
Union Con.	.40
Utah Con.	.01
Belmont	4.40
Jim Butler	.74
MacNamara	.08
Midway	.20
Mont.-Tonopah	.19
North Star	.17
Rescue Eula	.29
West End Con.	.67
Atlanta	.14
Booth	.08
Comb. Frac.	.05
D'field B.B.	.04
D'field Daisy	.04
Florence	.21
Jumbo Extension	.31
Kewanas	.18
Round Mountain	.39
Silver Pick	.24
Argo	.06
Ariz. Central	.10
Big Jim	1.25
Lazy Boy	.06
Nellie	.27
Tom Reed	1.87½
United Eastern	4.50
United Western	02

BOSTON EXCH.*	Jan. 23
Adventure	3
Ahmeek	102½
Algomah	1⅛
Allouez	65
Ariz. Com., ctfs.	13
Bonanza	.35
Butte-Ballaklava	1
Calumet & Ariz.	84
Calumet & Hecla	555
Centennial	22
Copper Range	65⅛
Daly West	2⅛
East Butte	14⅛
Franklin	8
Granby	85
Hancock	19
Hedley	‡24
Helvetia	.50
Indiana	2⅛
Island Cr'k, com.	66⅛
Isle Royale	33⅛
Keweenaw	4⅛
Lake	14⅛
La Salle	4⅛
Mason Valley	6
Mass.	14⅛
Mayflower	2⅛
Michigan	2⅛
Mohawk	84
New Arcadian	5
New Idria	13⅛
North Butte	21⅛
North Lake	2
Ojibway	2
Old Colony	2⅛
Old Dominion	63⅛
Osceola	86
Quincy	89
St. Mary's M. L.	85
Santa Fe	1⅛
Shannon	9⅛
Shattuck-Ariz.	26
So. Lake	5
So. Utah	.31
Superior	15
Superior & Bost.	6⅛
Tamarack	54
Trinity	5⅛
Tuolumne	.06
U. S. Smelting	63⅛
U. S. Smelt'g, pf.	51⅛
Utah Apex	2⅛
Utah Con.	18
Utah Metal	6⅛
Victoria	5⅛
Winona	4⅞
Wolverine	47⅞
Wyandot	1⅛

BOSTON CURB*	Jan. 23
Alaska Mines Corp.	1⅛
Bingham Mines	7⅛
Boston Ely	.50
Boston & Mont.	.75
Butte & Lon'n Dev.	.25
Calaveras	4⅛
Calumet-Corbin	.01
Chief Con.	1⅛
Cortez	.30
Crown Reserve	.43
Davis-Daly	6⅛
Eagle & Blue Bell	1⅛
Houghton Copper	1⅛
Iron Cap Cop., pf.	22⅛
Mexican Metals	.35
Mines of America	1⅛
Mojave Tungsten	1⅛
Nat. Zinc & Lead	.55
Nevada-Douglas	1⅛
New Baltic	2⅛
New Cornelia	18
Ohio Copper	1⅛
Oneco	.75
Pacific Mines	.35
Rex Cons.	.45
Rilla	.05

SALT LAKE*	Jan. 23
Big Four	.75
Black Jack	.07
Cardiff	6.25
Colorado Mining	.17
Crown Point	.04
Daly-Judge	8.50
Emma Cop.	2.12½
Empire Copper	1.70
Gold Chain	.15
Grand Central	.52
Iron Blossom	1.25
Lower Mammoth	.06
May Day	10½
Opohongo	.01
Prince Con.	1.27½
Seven Troughs	.04
Silver-King Coal'n	3.15
Silver King Con.	4.15
Sioux Con.	.13
So. Hecla	1.30
Uncle Sam	.04
Wilbert	11⅛
Yankee	.16

TORONTO*	Jan. 23
Bailey	.06½
Beaver Con.	.38
Chambers Ferland	.15
Coniagas	4.80
La Rose	.53
Peterson Lake	.11
Right of Way	.05
T. & Hudson Bay	68.00
Temiskaming	.59
Wettlaufer-Lor.	.07
Dome Exten.	.27
Dome Lake	.58
Foley O'Brien	.70
Hollinger	6.70
Jupiter	.32
McIntyre	1.97
Newray	1.40
Porcu. Crown	.77
Schumacher	.68
Vipond	.43
West Dome	.29

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Jan. 23
Cresson Con.	6.93⅞
Doctor Jack Pot	.09⅛
Elkton Con.	.12⅛
El Paso	.38
Findlay	.06⅛
Gold Sovereign	.06⅛
Golden Cycle	2.58⅛
Granite	.60
Isabella	.21⅛
Mary McKinney	.26
Portland	1.85
Vindicator	1.20

LONDON	Jan. 8
Alaska Mexican	£0 12s 6d
Alaska Tre'dwell	2 12 6
Burma Corp.	3 0 0
Cam & Motor	0 9 6
Camp Bird	0 6 0
El Oro	0 7 6
Esperanza	0 9 3
Mexico Mines	3 12 6
Nechi, pfd.	0 12 3
Oroville	0 16 0
Santa Ger't'dis	0 9 3
Tomboy	1 0 9

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	64.415	26.958	23.709	30.662
May	58.175	49.915	74.269	26.704	23.570	35.477
June	56.471	49.034	65.024	25.948	23.267	31.060
July	54.678	47.519	62.940	25.219	22.597	30.000
August	54.344	47.163	66.083	25.979	22.780	31.498
September	53.290	48.680	68.515	24.260	23.591	32.584
October	50.654	49.385	67.855	23.199	23.925	32.361
November	49.082	51.714	71.604	22.703	25.094	34.192
December	49.375	54.971	75.765	22.900	26.373	36.410
Year	54.811	49.684	65.661	25.314	23.675	31.315

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April	16.811	27.895	75.096	124.319	*	137.389
May	18.506	28.625	77.600	135.457	*	152.522
June	19.477	26.601	82.574	112.432	95.333	137.455
July	18.796	23.865	76.011	95.119	91.409	125.500
Aug.	16.941	26.120	68.673	110.283	82.333	126.304
Sept.	17.502	26.855	68.915	113.905	85.250	134.071
Oct.	17.686	27.193	72.601	122.750	88.000	142.523
Nov.	18.627	30.625	77.744	134.659	93.273	155.432
Dec.	20.133	31.890	80.773	145.316	100.430	162.842
Year	17.275	27.202	72.532	116.059		138.281

Tin	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	51.230	166.225	199.736
May	38.790	49.125	162.675	196.511
June	40.288	42.231	167.636	179.466
July	37.423	38.510	167.080	168.357
August	34.389	38.565	151.440	169.870
September	33.125	38.830	152.625	171.345
October	33.080	41.241	151.554	179.307
November	39.224	44.109	167.670	186.932
December	38.779	42.635	167.000	183.368
Av. year	38.590	43.480	163.960	182.096

Lead	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221	7.630	4.142	7.655	21.094	34.368
May	4.274	7.463	4.182	7.332	20.347	32.967
June	5.932	6.936	5.836	6.749	25.170	31.011
July	5.659	6.352	5.531	6.185	24.611	28.137
August	4.656	6.244	4.520	6.088	21.946	29.734
September	4.610	6.810	4.490	6.699	23.151	30.786
October	4.600	7.000	4.499	6.898	23.994	30.716
November	5.155	7.042	5.078	6.945	26.278	30.500
December	5.355	7.513	5.266	7.405	28.807	30.500
Year	4.673	6.858	4.567	6.777	22.917	31.359

Spelter	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012	16.695	9.837	16.525	49.888	99.056
May	14.781	14.276	14.610	14.106	68.100	94.217
June	21.208	11.752	21.038	11.582	100.614	68.591
July	19.026	8.925	18.856	8.755	97.250	50.750
Aug.	12.781	8.730	12.611	8.560	67.786	51.587
Sept.	13.440	8.990	13.270	8.820	67.841	52.095
Oct.	12.800	9.829	12.596	9.659	66.536	54.159
Nov.	15.962	11.592	15.792	11.422	88.409	56.023
Dec.	15.391	10.665	15.221	10.495	89.400	55.842
Year	13.230	12.804	13.054	12.634	67.553	72.071

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	21.65	13.45	18.95	13.95	19.48
May	14.61	21.78	13.60	19.11	13.83	19.58
June	14.70	21.95	13.67	18.95	13.77	19.34
July	14.94	21.95	13.91	18.95	13.68	19.20
August	16.01	21.95	15.31	18.95	14.75	19.22
September	16.86	22.88	15.95	19.58	15.70	19.53
October	16.95	24.61	15.96	21.26	15.80	21.51
November	17.57	30.07	16.47	28.18	17.20	26.55
December	19.97	35.16	18.44	30.95	18.95	30.79
Year	$15.82	$23.88	$14.76	$20.98	$14.95	$21.15

‡ As reported by W. P. Snyder & Co.